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Forestry at the Paris Exhibition of 1900.

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On the left bank of the Seine, just below the Pont d'Jéna, stands a fine building, chiefly of iron, wood and glass, adorned on its façade by scenes of forest and hunting life, either in frescoes or in groups of plaster statuary. Its lower floor is on the level of the quay, its first floor on the level of the bridge and the gardens of the Champ de Mars, while its galleries look out over the river and over the sunken road of the Quai d'Orsay. It has two angular red-tiled towers, somewhat recalling inverted flower pots, but is a fine and picturesque building on the whole. This is the "Palais des Forêts, de la Chasse, Pêche et Cueillettes," and is the home of most of the exhibition of objects which belong to classes 49 to 54 of the Exhibition Catalogue. The collections illustrating the fisheries of France and several other nations will be found very interesting, as well the exhibits of fire-arms, most especially remarkable among which is the collection of guns and other arms of various periods sent by the Emperor of Russia, in which may be seen the beautiful specimens of chased and ornamented weapons presented at various times to members of the Imperial Russian Court by the first Napoleon, the French Government and the city of Paris. Most of the chief English gunmakers have exhibits in this court. But what is of most interest to foresters is the series of exhibits shown by France, Russia, Austria, Hungary, the United States, Canada, Japan, Roumania, Sweden and some other countries, illustrating forest work and forest products. Indeed, most of the forest collections are here brought together, and it is only for a few that we have to go to other courts. Western Australia, India and Ceylon have each their collections in their own courts, so have Russian Siberia, Italy, Norway, Finland, Servia and Portugal, while the collections of the

French colonies are found in the different small houses in the Trocadero Gardens, in which are displayed the special exhibits of each.

2. The arrangement of forest exhibits has been determined by the classes appointed in the official catalogue. These are:—

Class 49. *Material and methods of exploitation and forest industries.*—Collections of seeds, plants, and specimens of indigenous and exotic forest species. Tools used in the collection and drying of seed, in nurseries, in forest works. Methods of nursery cultivation. Working-plans and methods of forest culture. Forest topography. Forest works, houses of the staff, saw-mill, systems of extraction and transport. Restoration of denuded slopes, fixation of dunes, etc.

Class 50. *Products of forest exploitation and forest industries.*—Specimens of forest produce. Timber and firewood, scantlings, cooperage wood, split wood, dye woods. Cork, textile barks, tanning, resinous and perfume-yielding products. Forest mines, industries, cork, charcoal, wood-wool, etc.

Class 54. *Appliances, implements and products of the collection of forest produce.*—Plants, roots, barks, leaves, fruits used in medicine, dyeing, paper-making, for oil, etc., etc. Caoutchouc, gutta-percha, gums and resins.

Classes 51 to 53 apply only to hunting and fishing.

Thus it will be seen that Class 49 is the class in which scientific forestry in general is represented; Class 50 deals with timber and timber works, and the large forest industries; while Class 54 deals with the various minor forest industries and the important minor products. The above classification is translated "very freely" from the French, but gives a better general notion of the real arrangement than does the translation printed in the Catalogue of the Royal Commission. It is perhaps a little unfortunate that, for jury purposes and for awards, the classification is somewhat difficult to follow. It is not fully clear at first sight whether timber specimens belong to Class 49 or to Class 50; but the answer is, if one thinks it over, that those specimens which illustrate trees, their size, growth and characters of wood, belong to Class 49, while those which are exhibited to show industrial value, capability for receiving polish, for use for special purposes as timber or furniture wood, and so on, belong to Class 50. The present paper is due to the facilities which I was afforded as a member of the jury of Class 49, for visiting and inspecting the different collections in that class.

30. The forest collections of *France* are all in the Forest Palace. They consist of a fine collection of wood specimens belonging to the Forest School at Nancy, with the addition of new specimens to represent species before imperfectly shown; of an admirable collection of fruits, cones and seeds of fruit trees; of a rich series illustrating the small forest industries and containing such articles as sticks, toys, sabots, baskets, agricultural implements,

pipes, bobbins, shuttles, fans, bellows, brooms, musical instruments and many others; a collection of the books published by the Government or written by Forest Officers; various fine pictures and photographs of the "reboisement" works, with two dioramic views showing the torrent of "La Grollay" in Savoy on one side at the commencement of work, and on the other ten years after the works undertaken for the stoppage of the torrent had been completed; working-plans and their results; models and pictures of forest houses, saw-mills, wire-tramways, and so on; and photographs and maps illustrating the splendid work done in the correction of the dunes on the coast of Gascony.

I was especially interested in the pictures of a forest-road called the Route de Combe de Laval in the Department of the Drôme, constructed in order to allow of the easy extraction of the timber and forest produce of the Forêt de Leute situated on the top of a plateau with precipitous slopes. The road reminded me of some of the Himalayan and South Indian hill roads, and notably of that from Kalsi to Chakrata. The project was, so M. Thil, the Inspector of Forests who is in charge of the Forest Exhibition, told me, made by M. Brive, and the work was carried out by M. de Rouville, both Forest Inspectors. The length was over 6 kilometres and the cost 171,788 francs. Much of the work was simply tunnelling or deep cutting in solid Jurassic limestone. A working model of a wire-tramway with endless wire working round horizontal or inclined drums at either end was also of interest. M. Thil was good enough to show me many books, working-plans, and other objects of much importance, and to explain the forest maps and the beautiful series of water-colour sketches, coloured and uncoloured photographs and maps illustrating forest work. The exhibition of the French Forest Department is ornamented by living specimens of young trees in fine growth contributed by the Forest School of "Les Barres," and by fine well-stuffed and life-like forest birds and animals, among which the "sanglier" is naturally conspicuous.

Among private exhibits, first and foremost perhaps are the portable tramways of Decauville & Co., whose chief agent, M. Schlüssel, was most kind, and as a fellow-member of the jury of Class 49, ready to afford information and explanations on all matters connected with forest transport. Forest saw-mills were exhibited, in full working, by M. Jametel of 41, Cours de Vincennes, Paris, and MM. Guilliet et fils of Auxerre, and I was interested to notice the vertical saw used, having the M teeth in the centre straight, and those above and below turned down and up respectively. Forest tools, guards' hammers and axes, saws, notably a very good portable band-saw, were exhibited by M. Emile Aubry of 131, Rue Vieille-du-Temple, Paris. M. Demorlaine, Garde General at Compiegne, exhibits an ingenious little machine for measuring the depth of the cuts (quarres) made for the tapping of *Pinus maritima* for the extraction of resin. As might be expected, the

well-known firm of Vilmorin-Andrieux et Cie have a magnificent exhibit of living specimens of forest trees, besides a very complete collection of fruits, cones and seeds. Finally the Forest Society of Franche-Comté, probably the chief and most energetic of the forest societies in the Provinces of France, shows maps of the forests of Levier and La Joux in the Jura, their own publications, and an ingenious "compas euregistreur," a caliper furnished with a small apparatus of two wheels, one of which unrolls a tape which is rolled on the other, and registers the diameters of the trees measured. Such an instrument ought to be very useful, perhaps not alone, but as a check on the note-books of the keepers of the records in a valuation survey.

Outside the Forest Palace may be seen some remarkable pieces of oak in log; a huge walnut stem, which ought to give an immense quantity of the best veneers; and two silver firs, one cut into a big beam, the other into planking. They were trees of 100 to 130 feet high and 2½ to 3½ feet in diameter. These firs are exhibited by M. Bouvet, Conseiller General, to show the size that the silver fir is capable of attaining in the Jura, and to prove that the local dealers are capable of cutting timber of the largest size the market is able to take.

The exhibits in Class 50 are numerous and very interesting to dealers and furniture-makers, less so to Forest Officers, but the beautiful specimens of valuable exotic woods, burrs and root pieces are worthy of notice. Among the exotic woods I saw teak, padauk, blackwood, satinwood and a wood that looked very like *Gluta travancorica*. The teak was a rather poor and very light-coloured specimen; it may perhaps have not been true teak, but one of the woods from W. Africa or Madagascar which dealers call African or other teak, but which come from trees in no way related to the *Tectona grandis* of India and Indo-China.

The official catalogue gives a brief but interesting account of the French Forest Service, which contains a considerable amount of valuable statistics and information, with a description of the chief systems of working, both in the Government and the Communal forests, and of the works undertaken for the "reboisement" of denuded hill lands and the fixation of dunes. A useful little work, copies of which were presented to the members of the Jury of Class 49, is the "Agenda du Forestier" or Forester's pocket-book published for the Forest Society of Franche-Comté by M. Paul Jacquin of Besançon. From it we gather the following statistics:—

	Sq. miles.
Area of Government Forest	4,205
Area of Communal Forest	7,404
Total ...	11,609

Of the Government Forest area, 2·5 per cent. is worked in simple coppice, 29·2 per cent. in coppice under standards, 16·8

per cent. in coppice under conversion, and 51·5 per cent. in high forest. In the Communal Forests, 68 per cent. is worked in coppice and 31 per cent. in high forest. The area of private forest is about 24,000 square miles, so that the total wooded area comes to nearly 36,000 square miles. The outturn in timber of the Government Forests comes to about 268 million cubic feet, of which about two-thirds is firewood. All produce is sold standing in the forest and removed by the purchaser.

The staff of the Forest Department consists of 1 Inspector-General, 3 Administrators, 32 Conservators, 200 Inspectors, 215 Assistant Inspectors, 250 "Gardes Généraux" and 3,500 "Brigadiers" and Forest Guards. The revenue comes to about £1,227,000, and the expenditure to about £560,000 yearly.

A most important part of the forest work in France is the re-clothing of denuded mountain tracts. In this work, in which such splendid success has been attained and of which the French Forest Officers are naturally very proud, the Government has spent over 2½ million pounds sterling partly in the *acquisition of* land, partly in works of restoration, and over 630 square miles have been thus reclaimed. Many important books and pamphlets were distributed, with great liberality, to the members of the Jury and to the Forest Congress. Among these are M. Mélard's valuable paper, often quoted herein, on the insufficient production of timber of construction in the world; the account of the forest of Fontainebleau by M. Reuss, and M. Prouvé's paper on regeneration by plantation. Then there are two important papers on the reclamation of dunes by Messrs. Delassasseigne and Lafond, and a splendid and most interesting series of works on "reboisement" by Messrs. de Gorsse, Buisson, Champsaur, Kuss, Campagne, Mongin, Bernard, Dellon, Calas, Banby and M. Bernard, some having plates of great interest, and all discussing important questions.

4. The forest exhibits of the *French Colonies* are also interesting. Chief among them naturally comes *Algeria*, whose exhibit is in their own building at the bottom of the Trocadero Gardens between the main central avenue and the British Indian and Canadian pavilions. In examining the exhibits, one's attention is at once drawn to excellent maps showing the extent of the forests of all categories, and a collection of photographs of the forests of the cork oak. The products of the working of the cork oak forest are shown by fine specimens of cork and sections of the tree in all stages. The Atlas Cedar is represented by a magnificent round, and the appearance and scent of the wood exactly recall those of the deodar of the Himalaya. Alfa grass and the alfa industry are well represented, as is also the "crin végétal," or vegetable hair, which is produced by the leaves of the palm *Chamœrops humilis.* Cups and vases, boxes and plates illustrate the beautiful marking of the root wood of the thuja (*Callitris quadrivalvis*), the result of frequent forest fires and the consequent

production of a multitude of root shoots. The forests of Algeria cover an extent of about 9,000 square miles, most of which is Government Forest. There are 3 Conservators, 17 Inspectors, 19 Assistant Inspectors, 31 "Gardes Généraux," and 860 Brigadiers and Forest Guards. The revenue comes to about £95,000 and the expenditure to about £124,000 yearly; the deficit being presumably covered by the surplus of the Forest Administration in France.

5. The *Tunis* section adjoins that of Algeria, and in a kind of miniature Arab town, are brought together exhibits illustrating the progress of the protectorate. In the forest section a good map shows the distribution of the forests, but, as in Algeria, the chief exhibits are those of cork furnished by the oaks (*Quercus Suber* and *Quercus Mirbeckii*) known to the French as "chêne-liège" and chêne-zéen." The Government possesses 317 square miles of cork oak forest, all under management and yielding an annual revenue of £24,000. The cork oak gives chiefly cork and tanning bark, and the zéen provides wood for construction purposes. An interesting exhibit is a relief map of the oasis of Nefta, where important works are being carried on to stop the damage done by drifting sand. There is also a collection of forest seeds.

6. The *Ivory Coast* Colony, adjoining the British Colony of the Gold Coast, has a small forest exhibit chiefly of wood specimens. The chief forest products of the colony consist of palm oil and nuts, india-rubber and mahogany; the latter, however, is not the same tree as that of the West Indies, but another species, indeed, belonging to some other family, whose identification does not seem to be yet certain. It is, however, a handsome wood and makes pretty furniture.

7. *Senegal* also sends a forest exhibit with maps of the country showing the localities where the chief trees are found, sections of wood, botanical specimens, and a manuscript list of the principal trees from which I gather that one of the most important is the Gum Arabic (*Acacia Senegalensis*). The other trees are, many of them, of genera well-known in India. Thus one of the chief furniture woods is yielded by *Afzelia africana*, a blackwood by *Dalbergia Melanoxylon*, a red cedar by *Cedrela odorata*, a good timber by *Terminalia macroptera*, while the *Borassus* palm appears to be as useful as it is in India. The numerons species of *acacia* seem to indicate a dry climate, though M. Schlüssel, who knew the colony well, told me that it is by no means all dry, but that in parts the forests were fine, and possessed large timber and a moist climate.

8. *Madagascar* exhibits an interesting collection of woods, carefully made and well-labelled, among which we noticed some fine ebony, blackwood and woods resembling those of the Indian *Mimusops* and *Chikrassia*. The whole exhibit is the work of a French Assistant Inspector, M. Girod-Genest, whose indefatigable

energy is shown by an album of coloured drawings of Malagasy trees, done by himself and accompanied by valuable notes on their uses and methods of growth. Considering the importance of the forest resources of Madagascar, it is astonishing to find that the representative of the Government in charge of the department is only an Assistant Inspector on the same rate of pay as he would be receiving in France. It is therefore all the more to his credit that he has been able to do so much.

9. The last of the French colonies represented, in a forest point of view, is *Indo-China*, the vast region adjoining the British dependency of Burma, which consists of the states of Cambodia, Anam, Cochin-China and Tonkin. Here, too, as in Madagascar, the Forest Officer is only an Assistant Inspector, M. Boude, but he has succeeded in bringing together a really valuable and important collection of timbers of the greatest interest. Fine pieces of teak from the Laos States, great rounds of a *Dalbergia*, a *Lagerströmia* with cork bands in the wood such as are seen in the Indian *Dalbergia paniculata*, and some *Menispennaceæ* and *Capparideæ* were those that chiefly attracted my attention. The officer in charge, M. Viterbo, from Hanoi, was most kind in explaining his Exhibition, and showed me also the admirable plates in the splendid "Flore Forestière de la Cochinchine," at which the veteran botanist M. Pierre is now working in Paris.

10. The forest exhibits of *Italy* are shown in the gallery of the splendid and highly ornamented Italian pavilion in the Avenue des Nations, the first met with on the left bank of the Seine, below the Pont des Invalides. Most important, perhaps, were the working-plan books and records, and the fine photographs of "reboisement" works in the Italian Alps. Among these I was specially interested in two, which represented the slopes at Sambuta, the first taken in 1889, and showing a very unfavorable looking locality; the second in 1899 showing the same with stone revetments in the lower valley and wattled barriers in the upper, and a fine set of young trees growing up, evidently bidding fair before long to convert the hillside into a useful forest. The collection of wood specimens was chiefly of young trees or branches cut longitudinally, and the two sections then hinged together. For the larger trees, these specimens were insufficient, but of the smaller trees and shrubs some were very fine and comparatively large. The flowers and fruit of the forest trees of Italy were represented by branches in spirit, and the seeds of the trees were shown in reversed bottles. There were also interesting collections of insects and fungi of importance in forest economy, as well as in agriculture. There were no private exhibitors in Class 49, but in the Engineering Section in the Champ de Mars is an exhibit of considerable interest showing the use of wire-netting in the protection of river banks, bridge piers and groynes, and in the works for the settlement of torrents. The netting is used instead of wattles for fascines, and has met with considerable success. The patentee of the system

is Giulio Serrazanetti of Bologna, whose interesting book on the subject was distributed to members of the Jury.

Italy possesses only about 15,800 square miles of forests, about 14 per cent. of her area, and these forests are of poor production only, so that the imports exceed in value the exports by a large sum.

11. *Spain* has no forest exhibition, and *Portugal* is represented but poorly in a small show in their National Pavilion. The chief exhibit was one of cork and objects illustrating the cork industry. There was a herbarium of plants and a collection of insects poorly named, as well as a set of wood specimens, shown by means of radial wedges mounted on wooden stands. But the most interesting part of the exhibit was in the picture of dunes and the photographs and maps illustrating the works undertaken to prevent their extension.

In the Portuguese Colonial Pavilion in the Trocadero Gardens are small forest exhibits from Timor and St. Thomé with some fine rounds of the woods of importance in those colonies. The forest area of Spain is about 25,000 square miles, being about 13 per cent. of its territory. That of Portugal is under 2,000 square miles. In both the imports of wood largely exceed the exports.

12. The forests of *Germany* are not represented in the Exhibition, but the Prussian Ministry of Public Works has a fine exhibit in the Champ de Mars, illustrating the works undertaken on the Northern Coast for the stoppage of the dunes and their re-clothing with forest. The works are illustrated by plaster models painted by H. Walger of Berlin and represent the "Kurische Nehrung," the narrow sandy belt between the sea and the Kurische Haff near Memel, in the extreme north-east corner of East Prussia. Works for the protection of the villages and cultivation on the Prussian coast from being damaged if not destroyed by shifting sands have been undertaken in many places on the coast of Germany, both on the North Sea and on the Baltic. Those of the North Sea have been completed, as have those of Mecklenburg and most of those in Pomerania, and it is only now in the extreme north-east that work still remains to be done. So far as I can gather from the official papers on the subject and from the models and photographs exhibited, there is very little difference in the system employed from that of the better-known regions of the French coasts of the Bay of Biscay, except that whereas on the French Coast it is the pinaster (*Pinus maritima*), which is chiefly employed, on that of Prussia the most important species is the Scots pine (*Pinus sylvestris*) aided, especially in a belt along the seashore by the *Pinus montana*. Great use is made of broken branches strewn over the ground among the young pines and in suitable places sea-grass or "gourbet" (*Ammophila*) is planted. A sum of about £4,000 yearly is spent on such works. In addition to the models, a fine collection of photographs is exhibited, as well as herbaria of

the plants commonly found on the coast sands, on well-prepared carefully mounted sheets. The jury were received and shown all these exhibits by Herr Bock, Inspector of Forests at Königsberg, who was most courteous and obliging. Germany possesses a forest area of about 54,000 square miles, about 26 per cent. of her area; but her imports of wood still very largely exceed her exports.

13. *Belgium, Holland* and *Switzerland* have no forest exhibits, nor has *Denmark, at any rate in Class 49. The areas of* forest in these countries are, approximately, as follows :—

Belgium	sq. m.	1,950	or	17	per cent.	of her territory.
Holland	"	960	"	7½	"	"
Switzerland	"	3,250	"	20	"	"
Denmark	"	930	"	6¼	"	"

in all, the imports of timber largely exceed the exports.

14. I now come to the magnificent forest exhibition sent from *Austria* and shown in several bays of the Forest Palace. Taken all round, it is probably the most complete of the non-French collections, though it is really difficult to say if it is really better than the fine exhibits of Hungary and Russia. Its chief advantage, however, over these latter, lies in its being all considered as one collection, while in the others several separate collections are shown, which perhaps, especially in the case of Hungary, make a better general show. In inspecting the Austrian collections the jury of Class 49 had the assistance of one of their members, Herr Ferdinand Wang, Conservator of Forests at Vienna, who was most kind and obliging, as was also Dr. M. O. Popper, Director of Domains, a member of the jury of Class 50.

The first thing to be examined was the beautiful forest map of Austria, which includes Bohemia and Moravia, on which can be seen at a glance the distribution of forest and the zones occupied by the chief classes of tree, firs, pines, oaks, etc.; also the administrative forest areas. Then we have a fine series of photographs, acting as object-lessons in sylviculture, all of them of importance, and most carefully selected. Various specimens of working-plans lie on a table accompanied by their maps and control-books, and illustrate the pains taken in Austria not only to ensure a proper management of the forest areas, but also to record and register information of value connected with them.

Timber-transport is illustrated by models, photographs and transparencies. "*Reboisement*" works are shown by tabular statements, maps, plans, models and photographs, mostly referring to the Tyrol and Salzburg. From a carefully prepared table, I gathered that the area so far treated amounts to 250 square miles and the money expended to nearly £100,000.

A very important exhibit is that of the experimental stations, the chief of which is the one at Mariabrünn near Vienna, which is probably the best equipped *forest experimental*

station in the world. There are others scattered all over the Empire, as may be seen from a map which illustrates them; and the chief subjects they consider are (1) cultivation of forest trees, (2) thinnings and cleanings, (3) production of material. While mentioning experiments, I may as well allude to a working model of a machine for testing woods which interested me very much. It is a very simple machine designed by Herr Friedrick of Mariabrünn, and made by the well-known firm of J. Amsler, Laffon and Son of Schaffhausen in Switzerland. It is worked by a small hydraulic press, which enables the weights to be gradually increased, and the increase to be accurately measured, and even the model which hardly stands more than 3 or 4 feet high can be made to test bars of a square inch in section for transverse strength or cubes of 1 inch for resistance to crushing weight. There ought to be a machine of this description in India attached to the Forest School at Dehra. Forest houses are illustrated by pictures which give the types on which the houses provided for the staff from the rank of Inspector down to that of Forest Guard, are built, and compare those built at the present day with the much less convenient houses of the past.

In frames on the wall is seen a series of specimens to illustrate the effects of judicious thinning, and some of the fine transparencies are also devoted to this subject. Other tabular frames show the effects of the smoke of factories on forest trees; while on shields are displayed the beautiful collections of forest tools and implements.

It would take long to describe in detail all the interesting forest exhibits of the Austrian section; in addition to what we have mentioned there are collections of seeds in reversed bottles (probably the best system yet discovered of exhibiting seeds as well as gums and other small articles of produce); specimens of wood sections; complete exhibits to illustrate the manufacture of wood-wool and paper pulp; and (most important) a full account with specimens to illustrate the distillation of wood and the manufacture from it of acetic acid, methylated spirit, creosote and other important chemical products. I regret that I had not sufficient time fully to examine and note about the fine collection under Class 50, chiefly the work of Dr. Popper.

The forest area in Austria is about 37,500 square miles or 30 per cent. of the area of the Empire, and the yearly production of wood reaches about a thousand million cubic feet. There is a considerable excess of exports over imports of wood, Austria being one of the few European countries in which this is the case. By the kindness of the Austrian Government, a number of valuable papers on forest subjects were distributed free to members of the Forest Congress and to members of the Juries. Some of the most important are the following:—

(1) The restoration of forest in the Karst on the coasts of Austria and Illyria, by Josef Pucich, Conservator at Trieste.

(2) The Home industries of wood in Austria, by Professor Lauboeck.

(3) The question of the beech in the Austrian forests, by Leopold Hufnagl.

(4) The disadvantageous influence of bad treatment on the future of forest growths, by Hermann Reuss, Director of the Forest School of Weisskirchen in Moravia.

(5) The study of the effects of damage to the bark of spruce trees produced by large game, by the same.

(6) Forest Police in Austria.

(7) The regulation of torrents in Austria.

(8) Guide to the Government Forests and those of public establishments in Austria.

The latter work gives a very interesting account of the Forest Department in the Empire. As before stated, the area of forest amounts to about 37,500 square miles, but of this only 5,868 are the property of Government or of public establishments. Of the forest area, 51 per cent. is spruce, 18 per cent. silver fir, 20½ per cent. beech or hornbeam, 4 per cent. larch, 3 per cent. pine, only 1·3 per cent. oak. The staff consists of one Ministerial Councillor, 9 Conservators, 109 Inspectors, 254 other officers, and 1,301 Forest Guards. The annual receipts come to rather more than £600,000 and the expenditure to about £478,000, but if full account is taken of the cost of direction on the one hand and the value of free grants on the other, the *net* revenue comes to nearly £175,000 which calculates out to about 1*s.* 3*d.* per acre.

15. The exhibits of *Hungary* compete, in extent and value, with those of her partner in the dual Monarchy. But they are split up among several exhibitors instead of being grouped together, and in any case *Croatia* and *Slavonia* forms a separate section. The Hungarian Forest Section, like that of Austria, occupies a considerable length on both sides of the building at the back of the Pavilion "des Forêts et de la Chasse" with the main path for sightseers passing down the centre. There is also an annexe in a chalet behind. On one side is a dioramic hunting scene with the animals of the Hungarian forests, some of them very cleverly set up and shown in life-like attitudes. The king exhibits wild boar heads, the Archduke Joseph Augustus 100 heads of roedeer, and other noblemen and sportsmen of Hungary exhibit fine trophies, with collections of guns from the most ancient old matchlock to the latest breechloader. The jury of Class 49 were again fortunate in having, as one of their members, the Officer in charge of the forest collections, who was most kind and most anxious to show us everything he could. This was Herr Jean Földi, Conservator of Forests at Buda-Pesth, to whom the arrangement of the splendid Hungarian forest collection had evidently been a labour of love. I do not propose to follow in the few remarks I have to make, the classification adopted for Jury purposes; all I can expect to be able to do is to indicate

the chief exhibits which interested me, and those to which a visitor might most satisfactorily devote his attention.

The most conspicuous object on entering the section, and the one which any visitor must first study, is a magnificent relief map of Hungary showing the forests. These relief maps are made by cutting out the contours on the staff map of the country and arranging them at the proper height one above the other. The "steps" between the contours can then be filled in, and the result is a relief map which only requires painting and printing to be ready for use. But the work is one requiring great care and taking much time, and the makers of the big Hungarian map, Messrs. Gregersen, Vaitzik and Terfi, deserve the greatest credit for the success of their work. There are other good maps also and many fine photographs.

The exhibition of working-plan books and maps, tables or production and analysis of typical trees, is one of considerable interest, as are the books containing historical descriptions of the forests. The volumes published by the Forest Society must be full of interest to those who read Hungarian. The damage done in Europe of late years by the "Nun" moth (*Liparis Monacha*) is well known, but it is not so well known that the results of using mineral tar to cover the holes of the trees for a certain distance and keep the caterpillars off, have often been a serious damage to the wood. An exhibit of sections shows how the parts covered with tar have got covered over and caused holes and bad places to be made. The damage is greater in broad-leaved trees than in conifers, and it is probable that if a vegetable tar is used the damage will be less.

There is a very fine collection of models, some of large size, illustrating forest fellings and extraction, works of re-clothing denuded areas, saw-mills, water-sluices, forest houses, etc. The finest of these models were prepared by Herr Charles Kaán, Forest Officer of Beszterczebánya. Another noticeable model is that exhibited by Herr A. Masztics of Liptó-Ujvár, representing a seed-drying house of a new and perfected design. The "sécherie" produces 6,000 kilos of seed yearly, and gives a yearly revenue of about £1,000. Another fine model is Herr G. Marton's model of "reboisement" work in the region of the Karst.

The Royal Forest School of Selmeczbánya (Chemnitz) exhibits specimens of the drawings done by the students; models of saw-mills, forest houses, seed factories, and works for the utilization of oak; plans and photographs of the school with maps and working-plans of the forests attached to it; books and instruments used in teaching; collections of insects, gall nuts, medicinal plants and the diseases of trees. The importance of this Forest School will be understood when it is known that in the eight years, 1881 to 1898, 1,306 students appeared for the final examinations, of whom 1,031 passed and received diplomas. There are also four secondary

schools and a separate school in Croatia-Slavonia. An account of the schools given in Colonel Bailey's paper on "*Forestry in Hungary*," published by the Royal Scottish Arboricultural Society in 1887, in which work is also given an excellent description of the Hungarian forests and an account of a tour made through them. It is at Selmeczbánya also that is situated the central experimental station whose publications form an exhibit and who also show a fine collection of the diseases of plants caused by parasitic fungi, which are excellently prepared.

Among noticeable exhibits is an excellent apparatus for sowing small seeds in nurseries exhibited by the Director of the Royal Forest School, Herr Louis Fekete. Another seed-sower, this time for large seeds, such as acorns and beech-mast, is exhibited by Jean Lotos, a forest guard. It is a plough with a share to open the drill, then behind it comes the arrangement for sowing the seeds, and this is followed by a reversed share which closes the furrow. Another useful instrument is a sowing stick, exhibited by Herr A. Gábor, which is used for dibbling large seeds like acorns in vacant spots in the forests.

I was much interested in an important series of photographs showing the growth of planted oak forest at intervals of 10 years from the sowing of the seed to its fitness for felling at 100 years of age. This is accompanied by a table of the production of oak and the working-plan of the Forest of Balincz, made by Herr Attila Párnai. I was also struck by the value of a new forest compass "Système Csiby" which combines a theodolite, compass, and plane table. It seems to me an improvement even on the excellent instrument in use in France and which we employed at Nancy. I was told that its cost was 360 francs. It would probably be well suited for forest survey work in India.

To enumerate all the many interesting things in the Hungarian exhibition would be impossible, and it is sufficient to add that the collection of wood specimens and specimens to illustrate forest industries, and especially the cutting of veneers, is very complete.

The collection of Croatia-Slavonia occupies a corner and also the chief part of the chalet outside the Forest Palace. The Forest School of Zagráb exhibits a collection of oaks and their acorns, and a set of the tools used in forest work in the great oak forests of the province. The Forest Association exhibits their publications, with a fine map, photographs, collections of wood-sections and manufactured articles. The chief species of tree are the oak and beech, the forests of which occupy about 29 and 60 per cent. respectively of the forest area, leaving only 11 per cent. for conifers. The oaks are sometimes of very large size as may be seen from the splendid specimens of which the chalet is constructed. One of these was about 42 feet long, 50 inches in diameter in the middle, and had a content of about 570 cubic feet. It was about 300 years old, and there were several others nearly as big used as supports for the

building. One specimen had about 10 feet diameter. The size and straightness of the Slavonian oak timber was most striking.

The area of forest in Hungary comes to about 29,000 square miles, that in Croatia-Slavonia 5,800 square miles, total 34,800 square miles, making about 28 per cent. of the area of the kingdom. Of the Hungarian area, 4,400 square miles belong to the Government. The beautiful relief maps already referred to show the distribution of species very well, firs on the mountains, oak along their bases, beach on the slopes. The oak forests constitute 28 per cent., the beech 51 per cent., and the remaining 21 per cent. only are conifers. The usual rotation of high forest is 100 years, and every endeavour is being made to replace the beech, which is of small value, by oak and other more valuable kinds. I have not been able to find the revenue and expenditure of recent years, but Colonel Bailey gives it for 1885 as revenue £500,000, expenditure £332,000, surplus £168,000. It is now probably considerably more. As is the case for Austria, so in Hungary, the exports of timber largely exceed the imports. M. Mélard (Insuffisance de la production des bois d' œuvre dans le monde, Paris, 1900) puts the value of this excess at 8 million pounds sterling. The most noticeable point about the forest literature and the forest exhibits of Hungary is the evident desire of the State to improve the administration of the forests, to restore areas denuded of forest to their former condition, and to foster in every way the increase in the forest area in view of the benefits which are to be expected from it both financially, industrially, and in its effect on agriculture.

The staff consists, for the Government Forests of Hungary and Croatia-Slavonia, of the following officers (using the terms which make the grades correspond as nearly as possible to those of France):—

	Hungary.	*Croatia-Slavonia.*
Inspector-General	3	1
Conservators	10	2
Inspectors	23	6
Assistant Inspectors ...	100	24
Gardes Généraux	291	48
Brigadiers and Forest Guards ...	1,012	317

Among the valuable and important pamphlets on forest matters in Hungary, distributed to the members of the Jury and to those of the Forest Congress, the following are most noticeable:—

(1) Orders regarding working-plans.

(2) History of the Forest School of Selmeczbánya, by E. Vadas.

(3) Organization of the special schools for Forest Guards.

(4) Plantation and cultivation of willows as a protection against inundations, by Ignace Darányi.

(5) Measures of defence against the "Nun" moth, by F. Szakmáry.

(6) History of the National Forest Society.

(7) History of the question of forest experiments.

(8) Law No. 31 of 1879 on forests.

The general catalogue of the Exhibition of Hungary and the special forest catalogue also contain most interesting information.

16. The forests of *Bosnia-Herzegovina* are not represented by exhibits, but it is right to draw attention to the pamphlet by Herr Ch. Petraschek, the head of the Forest Department, on the development of sylviculture in these States, which are under the protection of Austria-Hungary. It explains how, when the States were taken over in 1878, a Turkish forest law was found which had never actually been put in force, but which has been made the basis of the forest work of the future. The area of forest is more than 10,000 square miles, 80 per cent. of which belongs to the Government, but much overburdened with customary rights. There is a large stock of over-mature oak which is now being exploited, but with great attention to the maintenance of the annual yield and improvement,—a practice, which is of interest to all those who, like the Forest Officer in India, have to deal with forest fires, is worth noting. When the person who has fired the forest cannot be discovered, the commune on whose territory it has broken out, is expected to fence the forest and maintain the fence as long as may be necessary to ensure reproduction. The application of this measure has had a great success in stopping incendiarism.

17. *Roumania* has a large Government forest exhibit in the Forest Palace with a separate exhibit of even greater value in the Roumanian National Pavilion in the "Rue des Nations" for the Crown domains. This latter collection has a fine relief map; a good series of photographs; a collection of specimens of wood in book form with the bark at one end and a sliding glass panel at the side which discloses specimens of the leaves, flowers and fruit; a herbarium of forest plants, and a series of models. The chief of these models is one of the methods of extraction of timber by means of forest railways, and another shows a saw-mill with 10 vertical and several circular saws.

The Government collection chiefly contains exhibits of worked-up timber, such as pieces of oak for cooperage, parquet floors, veneers, etc., but there is also a splendid series of photographs of forest scenes and forest works, and some excellent large maps to illustrate the distribution of forest in the country. The sections of trees are also well prepared and interesting. A felling saw is exhibited by Messrs. Davidovici Brothers of Bacan, worked by a band from a stationary engine, but it is not nearly so good as the felling saws exhibited in the English section by Messrs. Ransome.

The area of State Forest in Roumania is about 4,200 square miles. About half of this area consists of beech or beech mixed either with coniferous trees or with oak and hornbean, a quarter per cent. is oak forest and the rest conifers or white woods with

a small quantity of acacia. The revenue is about £1,600,000, the expenditure about £600,000. Only about one-tenth of the State Forest area is as yet under working-plan. The exports exceed the imports of timber.

18. In the National Pavilion of *Servia* is a fair map of the distribution of the forests, which are, however, mostly private; books on forest administration, and a small collection of forest tree seeds in inverted bottles. The area of forest in Servia is about 8,000 square miles.

19. *Bulgaria* shows chiefly specimens of wood cut so as to show the bark and the transverse, radial and tangential sections. A collection of walking sticks is noticeable also.

20. *Turkey* and *Greece* are not represented, and I have not succeeded in finding information regarding the forest area possessed by them or by Bulgaria.

21. The exhibits of *Russia* are in three chief collections—(1) that of the Ministry of Agriculture shown in the Forest Palace, (2) that of the Imperial Apanages shown in the Siberian Pavilion, and (3) that of Finland in the Finish Pavilion in the Rue des Nations. They are all fine collections and contain objects of the greatest interest. For the study of these objects in the Russian Pavilion, the Jury of Class 49 had the assistance of one of their members, M. Edouard Kern, Director of the Imperial Forest School at St. Petersburg; and for those of the Apanages we had the guidance of M. Honoré Yol, who was most courteous and kind, and who received his visitors in a charming room, reproduction of one at the Kremlin, and allowed them to taste the excellent wines produced on the Imperial Estates in the Caucasus, and drink the health of His Majesty the Emperor.

The collection of the Ministy of Agriculture occupies several bays and on a wall at the beginning is seen the forest map of Russia, the colouring of which is very interesting. From it it appears that the chief forest areas are, as might be expected, in the north. Another map shows the forests of Siberia and Central Asia. There is also a large collection of photographs of different aspects of forest growth and of all kinds of trees. The working of the forests is illustrated by the working-plans of selected areas and the books and orders relating to the subject. Administration and Police are illustrated by tabular statements, books and papers, drawings of uniform, and pictures of the forest houses for all grades. The Forest School is represented by photographs of the buildings, tables and diagrams, manuals, maps, etc., as well as by excellent specimens of the work done by the students.

The collection of wood specimens is probably the most complete and the best arranged in the exhibition. The specimens are large, perhaps 3 feet high, and are cut so as to show the

grain on the various sections and very carefully labelled. As an example, I quote:—

"Larch (*Larix Sibirica*), age 115 years. Height 22 m. Diameter 36 m. Specific weight 0·647. Resistance to compression 787 kilos per cent. square. Composition of Forest: Larch 0·3, spruce and silver fir 0·4, birch 0·2, pine 0·1. Density of growth 0·9. Contents of forest 400 metres cubes per hectare. Soil sandy, fresh."

The forest herbaria exhibited are very good, and among the trees of which specimens are shown, are some of much interest.

The collection of the Imperial Apanages is also an interesting one with another collection of wood specimens and a good show of timber in scantling, the different planks, etc., arranged in a revolving case so as to be easily inspected.

The Muscovite Society of forest working exhibits maps, photographs and models of forest works, and the Forest Society of St. Petersburg their publications. There are several private exhibits, most noticeable among which are the albums and forest products exhibited by M. Poliakov of Taganrog in the province of the Don; the instruments shown by M. Miassoëdev and the products shown by Baron Steingel of Koubanskaia.

The exhibition of Finland was also a very interesting one. The forest map shows the great forest resources of the country, but it was explained that the fine timber is chiefly in the south and that towards the north the trees get more and more stunted. As an example, there is exhibited in the Russian Court a section of Scots pine from Lapland 200 years old, but having only a diameter of less than 5 inches. Three beautiful photographs give an idea of the Finnish forests, while other photographs show the tar-industry which seems still to be carried on in a rather primitive fashion. The specimens of woods are well prepared, but naturally not numerous, the spruce, Scots pine, birch and the European and Siberian larches being the principal species. The use of birch-knots and burrs for furniture and ornamental articles is well illustrated.

The Forest School of Evois shows a collection of maps drawn by the students, illustrating the neighbouring forests and their working-plans; while timber transport is illustrated by models of rafts, boats, sledges and other similar works.

I noticed particularly an implement I had not seen before, used for making planting holes. It consists of a strong iron crowbar pointed at the end and surrounded by an iron circle with spikes. It is easily understood that if the crowbar is pushed into the ground far enough, it makes a hole for the tap-root, while the ring of spikes stirs up the surface soil. In soft soils such an implement might be a saving; in hard soils it would hardly work; in either case the labour would probably be nearly as great as that necessary for the use of the spade. There is also a fine exhibit of forest tools and implements, and to conclude, I may

mention the beautiful stuffed birds, especially a magnificent owl, the *Strix lapponica;* and the interesting furniture in the charming Finland Court, which well deserves a long visit, and is one of those in the Avenue des Nations of most interest and best taste.

The vast extent of the forests of Russia, including Finland, may be understood from the fact that they consist of about 618,000 square miles, which is 32 per cent. of the area of the territory. In addition 87,000 square miles are in Finland, and represent about 60 per cent. of the province. In Siberia there is a further very large forest area. Of the Russian area, 64 per cent. belongs to the State; 23 per cent. to private owners; 8 per cent. to communes; 3 per cent. to the Imperial Apanages, and the rest to different public establishments. The chief tree is the spruce, pure forests of which cover enormous areas; next come in order the Scots pine, oak, larch, beech, lime and poplar. In Poland are found the silver fir and beech, while in the Caucasus among the chief trees are the *Abies Nordmanniana* and the *Picea orientalis.* The occurrence of pure forests of the lime in some Governments, especially Kostroma, Viatka, Kazan and Oufa, is remarkable. The wood is much used, as well as the bast, which latter serves for making shoes, baskets and boxes. In the Siberian forests the *Larix Sibirica* and *Abies Sibirica* are notable species.

It is difficult to describe easily the grades of the officers of the forest service, but, so far as I can make out, there are one Director, 2 Sub-Directors, 49 Conservators, 1,144 Inspectors or Foresters, 1,865 Assistant Inspectors of various categories of service, 5,186 Brigadiers, 19,102 Forest Guards and 6,165 Guards of other titles. The Forest School is at St. Petersburg, where the number of students is usually about 500; and there are 30 secondary schools with about 537 students. The preparation of working-plans began in 1840 for Russia, and in 1898 for Siberia, and the work is making great progress.

The revenue of the forests in 1898 came to £6,670,000, the expenditure to £1,270,000; so that the net revenue was about £5,400,000.

I may conclude by mentioning the interesting descriptions of the Apanage forests of Nelengsko-Kokovinskaïa and Krasnostanskaïa, copies of which were distributed to the members of the Jury and to the Forest Congress, and in which the nature of the systems of working employed in Russia may be excellently studied.

22. The forest exhibits of *Sweden* are in the gallery of the Forest Palace, where attention is at once drawn to the diorama of a Swedish pine forest with actual tree trunks and a lovely distant view of a lake and mountains.

Close by is a fine model of a saw-mill on the coast with the transport roads leading from the interior and ships in front

loading up scantlings for export; and alongside is a well arranged exhibit of wood paving blocks arranged to show the marks of the various companies and persons who export. A large map gives a good idea of the extent of forest in Sweden, and there are excellent collections of woods, cones and seeds, wood-pulp, wood-wool, and the products of carbonisation. Among the wood specimens I noted two of nearly the same size, one from a tree 37 years old, the other from a tree 220 years old. They had grown barely 6 feet apart, but in one case the land had been drained, in the other it was still marsh.

The area of Sweden is about 159,000 square miles, and of this area more than 47 per cent. is forest, the Government Forest estate occupying about 28,300 square miles. It is unfortunate that Herr Lundström's account, in the special forest catalogue, gives little or no information regarding the management of this area, but only treats of the utilization of the produce, and states that a good deal of drainage and plantation work is being effected. It does not even say whether any of the forests are under working-plan or not. The chief species of tree are, as is well-known, the Scots pine and spruce.

23. *Norway* is scarcely represented at all as regards its forestry, the only exhibitor in the National Pavilion being Herr Ring of Christiania, who shows a simple system of sledge for the extraction of large pieces of wood in season of snow. The framework is very light, so that it can be carried back by one man. The area of forest in Norway is 26,000 square miles, or 21 per cent. of the country. The imports, of course, are very small in comparison with the exports, but the progress made in forestry to ensure a permanent yield has not yet been very great.

24. *Great Britain* also is not itself represented officially, only British India, Ceylon, Canada and West Australia appearing to represent the Empire. But it is right to draw attention to the excellent saws, the special tree-feller and a cross-cutter exhibited by Messrs. A. Ransome & Co. of Newark-on-Trent. The tree-feller is worked by steam passed through a strong flexible steam metallic hose, which may be as long as 60 feet from the boiler, which is light and easily wheeled about. For felling trees on fairly level ground, where a large exploitation is made and a number of trees felled close together, the use of such a machine is a great saving in cost. The British forest area is, according to M. Mélard, about 4,750 square miles, or 4 per cent. of the surface of the country. The imports are immensely in excess of exports. The area of Government Forest is very small indeed.

25. The collection exhibited by *British India* is shown in the gallery of the Indian Pavilion in the Trocadero Garden. But all the Imperial Court is to some extent a forest exhibit, for it exemplifies the use of the chief Indian woods for carving, decoration and furniture, by means of handsomely carved show-cases and other exhibits. Much of the central trophy, the Travancore show

case, and the grand staircase are of teak wood (*Tectona grandis*), the Madras show-cases and parts of the central trophy, of black-wood (*Dalbergia latifolia*); furniture, most of the tea-court verandah, and one arch of the central trophy, of sissu (*Dalbergia Sissoo*) and other parts or articles of Padauk (*Pterocarpus dalbergioides*), sandal-wood (*Santalum album*), and cedar (*Cedrus Deodara*). Much of the carved work was prepared by officers of the Indian Forest Service under the supervision, often from the designs, of the Inspector-General, Mr. B. Ribbentrop. The Jury was guided over these collections by myself. In the forest collections, the maps of the forest, the working-plans and the various forestry and other works prepared by officers of the department, are the exhibits of most interest in a scientific point of view. There are also models to illustrate the use of elephants and buffaloes in timber extraction; models of forest houses and the houses of native forest tribes; large collections of arms and implements and a fine set of panels representing the chief furniture woods, named and polished. Then there is the excellent collection of articles of minor forest produce, consisting of barks, roots, leaves, flowers, fruit with gums, resins, oils, india-rubber, fibres, etc., and a set of small objects to illustrate small forest industries: this collection was made at and sent from the Imperial Forest School at Dehra Dun. A large trophy illustrates the bamboo and the various uses to which bamboo is put in India; while the important sandal-wood trophy which has specimens of the various qualities of commercial sandal-wood, was sent by the Maharaja of Mysore, whose Conservator of Forests, Mr. J. L. Pigot, is the author of the pamphlet on the subject.

The area of forest, the property of Government, under the Indian Forest Department, is about 120,000 square miles, of which over 80,000 square miles are specially reserved for permanent working. Nearly 30,000 square miles are under working-plan. The staff of the forest consists of one Inspector-General, 19 Conservators, 180 Inspectors and Assistant Inspectors of the Imperial and 112 of the Provincial Service, 437 Rangers, 1,226 Foresters (Brigadiers) and 8,533 Forest Guards. The members of the Imperial Service, almost all European, are recruited from the Forest School at Cooper's Hill in England; those of the provincial staff, partly European, partly native, from the School at Dehra Dun in India, where there is also a Secondary Forest School for the training of Foresters. There is another Secondary School in Burma. The Bombay provincial staff is trained at the College of Science at Poona.

The revenue of the Indian forests is nearly £1,200,000, the expenditure nearly £700,000, so that the net revenue is about £500,000.

The chief timber tree of India is the teak (*Tectona grandis*), the exports of which amount to about four million cubic feet

yearly. "Padauk," a red furniture wood from the Andaman Islands, is also considerably exported, as is the Blackwood or Rosewood of Western India. In Northern India the chief timber for building is the sâl (*Shorea robusta*), while the Himalayan cedar (*Cedrus Deodara*) is universally employed in Public Works, especially for railway sleepers. Ebony, Satinwood, Sandal-wood, Walnut, Boxwood, Red Sanders, Sappanwood, Palmwood, rattans and bamboo are exported to some extent, as are the minor products—india-rubber (*Ficus elastica*), lac, cutch, gum arabic, wild silk, myrabolams (*Terminalia chebula*), gamboge and gutta-percha.

26. *Ceylon* has no exhibits in Class 49, but in Class 50 shows a fine collection of woods, among which the Calamander ebony (*Diospyros quæsita*) is especially noticeable, with the Palmyra and Cocoanut palms, and many other woods of local value. It is from Ceylon that comes a large amount of ordinary ebony and a quantity of the valuable satinwood (*Chloroxylon Swietenia*) so well known for its use in making brush backs and fine furniture. Tanning materials, gamboge and gum resins are also exhibited. All these have been arranged by Mr. W. E. Davidson, whose beautiful catalogue is a model work of much value, but omits an account of the Forest Department. The area of good forest in Ceylon is said by Mr. Davidson to be 12 per cent. of the area of the Island, *i.e.*, about 3,000 square miles. The present Conservator is Mr. A. F. Broun.

27. *Western Australia* also has no exhibit in Class 49, but in Class 50 shows a splendid set of timbers, among which the huge logs of Karri and Jarrah (*Eucalyptus*) are especially noticeable. Nearly all the woodwork of the Court is made of these two timbers which are in considerable use for wood-paving in London and other large towns. Many other valuable woods are shown, and the capabilities of the West Australian forests in respect to furniture woods are exemplified in a fine table made of various species cut so as to show the grain to the best advantage. According to M. Mélard, Australia, as a whole, possesses about 125,000 square miles of forest, *i e.*, about 4 per cent. of the surface.

28. The forest exhibits of *Canada* are shown in the Forest Palace and are well worthy of study.

The collection of woods is very complete and very well prepared, and rivals that shown by Russia. The account of the "Forest Wealth of Canada," prepared by Mr. James Macoun, the officer in charge, is excellent, and I was glad to read in it that "the various Governments are taking steps towards the reforesting of the denuded areas under their control, and though the actual work so far done in this direction is not great, preliminary investigations are being made, which will enable them to apply the methods best suited to each district."

A remarkable exhibit is a fine series of photographs of Canadian forest trees, each framed in the wood of the tree

represented. These are exhibited by the Geological Survey of Canada and number 86 in all. Some of the trees are represented also by large rounds or big planks, and each species is accompanied by specimens of the articles chiefly made from it. Thus, for example, the sugar maple *(Acer saccharinum)* is represented by "sections of log, square timber, boards, polished panelling, blocks and squares, chair parts, kitchen utensils, butcher's skewers and other specialities."

The chief timber trees of Canada are: White pine *(Pinus Strobus)* better known in Europe as Weymouth pine; white spruce and black spruce *(Picea alba* and *Picea nigra)*; Douglas fir or "Oregon pine" *(Pseudotsuga Douglasii)*; Giant arbor vitæ *(Thuya gigantea)*; Sugar maple *(Acer saccharinum)*; white oak *(Quercus alba)*; and black walnut *(Juglans nigra)*. Mr. Macoun, in his interesting *catalogue*, gives the following information regarding the value of Canadian timber exports:—

	£
Nova Scotia	556,271
New Brunswick	1,319,939
Quebec	2,455,416
Ontario	2,120,473
British Columbia	153,240

the other colonies as yet producing only timber required for home consumption.

The forest area of Canada is estimated by M. Mélard at about 1,250,000 square miles, or 38 per cent. of the area of the dominion.

29. The Forest exhibition of the *United States* is partly in the gallery of the Forest Palace, partly in a charming log chalet behind. The collection was arranged by Dr. Bean of the Department of Agriculture, to whom I am greatly indebted for much information and kind help in seeing all his interesting exhibits. First in importance comes the collection of photographs and transparencies exhibited by the Ministry of Agriculture in Washington. The transparencies have been very justly admired by all who have seen them; and conspicuous among them are those of the giant trees of the Western States, *Sequoia gigantea* and *Sequoia sempervirens*. With these are also exhibited the many useful Government publications which are well known and which are so well printed and arranged and so liberally distributed; also a great set of transparencies of wood sections giving many more specimens than are published in M. Hough's work. The "forest service of the State of New York" exhibits fine wood specimens, well arranged; and the "Forest Commission of California" a collection of furniture woods prepared to show their capabilities both in block and in veneer.

The "Forest and Stream Publishing Company of New York" exhibits its journal "Forest and Stream," but this journal is really more devoted to sport than to forestry.

The exhibit of the "Southern Railway Company" is in the chalet and consists of a picture of a saw-mill with the streams and railroads serving it, and a collection of photographs of forest scenes. Mr. Romeyn Hough's collection of photographs of type trees and his seven volumes of wood sections known as "American woods," each plate giving as a hand transparency the transverse, radial and tangential sections, was much admired; while his valuable works on Forestry were shown by Dr. F. B. Hough. The "Elements of Forestry" is his best known book. The United States have as yet no regular forest service, but some of the States have begun to make reservations and to introduce methods of economy. According to M. Mélard, the approximate area of forest is rather more than 3 million square miles, being about 25 per cent. of the total area. The value of the timber imports is considerable, being about £1,900,000, while that of exports is about £5,900,000.

30. The exhibits of *Japan* also come in the gallery of the Forest Palace, but chiefly belong to Class 50 rather than to Class 49. In Class 49, however, come some interesting things: there are maps of the forests and photographs: in the chief map it is interesting to see that the country is divided into four zones—(1) the Tropic Zone, characterized by *Ficus Wightiana*, (2) the Warm Temperate Zone, characterized by *Quercus sempervirens*, (3) the Cold Temperate Zone, characterized by *Fagus japonica*, and (4) the Cold Zone, characterized by *Abies Veitchii*, *Mariesii* and *Sachalinensis*.

Noticeable is a collection of woods arranged in a frame, each species being represented by radial and transverse sections and a slab of bark. A very fine exhibit is one of sections of *Cryptomeria japonica* taken at intervals of 2 metres and arranged in order to show the growth, and the curve of growth for the whole section and for sapwood only. The sections are cut so that one side is the diameter. Besides the *Cryptomeria* several other trees are thus illustrated. Perhaps the most remarkable exhibit is the collection of bamboos, of which 46 varieties are shown, prepared for export by the manufacturer Mr. D. Nagata of Hiogo. They are accompanied by a fine herbarium. The culms are all beautifully blotched and marked, and it is difficult to say how far this has been done naturally or artificially. The largest species is called "Mo-so."

An interesting pamphlet distributed to the members of the Jury, gives an account of the trees of the division in the north of Japan called Hokkaido, which chiefly consists of the island of Yezo. Here the area of forest is about 24,000 square miles, nearly all "Imperial," or "State," the difference between which categories is not explained, but the area is 66 per cent. of the area of the division. The list mentions 50 important species, and describes No. 18 "Sennoki" (*Acanthopanax ricinifolium*) and No. 20 "Yachitamo" (*Fraxinus mandshurica*) as the most useful timbers. It is not surprising to find an ash so well spoken

of, but it *is* so to note that an Araliaceous tree is so valuable. No. 1 "Katsura" (*Cercidophyleum japonicum*) is also said to be important, and among conifers No. 43 "Asunaro" (*Thujopsis dolabrata*), No. 47 "Kuroyezomatsu" (*Piceaicca ajanensis*) and No. 50 "Shikotanmatsu" (*Lerix dahurica*) are recorded as apparently the most valuable. Specimens of all the woods mentioned find place in the panels. Japan has many other exhibits, mostly in Class 50, to which class I regret I am unable to do justice here. According to M. Mélard, Japan imports rather more timber than she exports, the figures being: imports £50,000, exports £36,400; and he thinks that with care her forest resources should suffice for her needs. Japan has already established a good forest administration and good schools, and I can only regret that I cannot add any fuller information regarding them. The forest area is about 46,000 square miles.

31. There are no exhibits from any part of America except the United States, Canada and the French West-Indian Islands. Mexico has some interesting woods, probably in Class 50, and some of the South American countries may have similar exhibits, but none are represented in Class 49. In Asia the chief omission besides Ceylon is Netherlands India, which has a well organised forest service and some very valuable teak plantations. In Africa, the Cape Colony and its Forest Department are not represented, nor are the German Colonies or the Congo. Only the Portuguese Colonies show a few exhibits of wood specimens and minor produce.

Note on the Larva of Eublemma amabalis, Moore, as a Lac Insect-destroyer, in the Damoh Division, C. P.

BY D. O. WITT, *I.F.S.*

To those interested in the propagation of lac which in many of our forests is an important article of minor produce, the following notes on the above-mentioned insect may prove of interest.

In the Damoh Division of the Central Provinces lac is a very important item of minor forest produce and is propagated almost entirely on *Zizyphus xylophyra* (vernac., Ghaunt or Kather), though also to a certain extent on *Butea frondosa* (vernac., Chula).

There are two crops of lac each year formed by the young larvæ of *Tachardia lacca*, the first swarming out in July and the second in November. The lac in which the larvæ of *Eublemma amabalis* were found, was that produced by the July brood. I first noticed the attacks on the 26th September and collected some of the larvæ. The larva is white and unmarked, the head only being dark. It appears to feed upon the soft bodies of the lac larvæ, taking up its abode with them beneath their resinous coating and forming a webbed covering connected with the outer air by a silken tube woven together with an admixture of reddish

excreta. Whether the tube is formed just previous to pupation, as a tunnel of escape for the perfect insect, I am not aware. Mr. G. C. Dudgeon, F.E.S. of Palampur, Punjab, to whom I am indebted for the naming of the insect and to whom I sent specimens of the larvæ, perfect insect and a specimen branch of the lac incrustation attacked by the larvæ of *E. amabalis*, is of opinion that these silk tubes are made as a tunnel of escape, as the tubes are all of the same size and therefore presumably formed by larvæ in the same stage of development; and portions of the pupa shell were found inside the resinous coating just beneath these tubes. On the other hand, I did not notice that these tubes were ruptured by the emergence of the perfect insect.

Six imagos of the larvæ which I collected early in November 1899 emerged between January 12th and 20th, 1900. Three more between January 22nd and 27th and two more on February 17th. It would appear therefore that one generation of the insect lasts about seven months, as the lac incrustation only begins to form in August.

Mr. Dudgeon informs me that so far *E. amabalis* has only been recorded from Ceylon and Sikkim, and now Damoh. It would appear therefore to have a wide distribution and it would be interesting to know whether it affects for instance the lac in Bengal and Assam. I also understand that it adds only the second species to the genus *Eublemma* now known to feed on a species of *Coccidæ*, the other described one being *E. coccidiphaga*, Hampson. It would thus appear that there is considerable room for investigation in this matter both with reference to *E. amabalis* itself and other members of the same genus. Among the more interesting points requiring investigation with regard to *E. amabalis* I may mention the following in the hopes that they may bring forth some information from other quarters:—

1. Does *E. amabalis* attack both crops of lac? (So far I have only found it on the winter crop.)
2. Does it attack lac on trees other than *Zizyphus xylophyra*?
3. How many generations of the insect are there a year? (There must surely be more than one because the interval between January when the imagos emerged, and August when the winter crop on which I found the larvæ commences to form, is unaccounted for.)
4. The eggs, their form, colour, etc., and where they are deposited.

Other points will suggest themselves to those interested in the matter, and I therefore need not add to the above.

Owing to my being transferred to another district I have been unable to continue my investigations on this interesting insect, but the above notes may lead to some one filling up the gaps I have mentioned.

Burma.*

BY MAX FERRARS, INDIAN FOREST SERVICE (RETIRED).

This is a beautifully illustrated work giving an interesting account of the inhabitants of Burma, a people possessing many peculiar characteristics, owing to their comparative isolation, and whose manners, customs and institutions have undergone but little change in the course of ages. The numerous illustrations, which convey a very graphic idea of the domestic life of the inhabitants of this portion of the Empire, are all from photographs executed in a highly artistic style, and in the selection of the views given great taste and skill are displayed. The scenery of the country of which many examples are shown, is remarkably beautiful, as the vegetation is most luxuriant. The volume is extremely well printed and bound in a very appropriately designed cover. In the appendices are some notes on Burmese music, with a few annotated specimens, showing that the Burmese have made some progress in the art. A useful map of the country and an index are appended. —*Imperial Institute Journal.*

* Burma. By Max and Bertha Ferrars. With 450 Illustrations from Photographs. Sm. 4to., 11 in. × 9 in.; pp. 237. Price, 30s. nett.

V.—SHIKAR, TRAVEL, &c.

Cowardly Elephants.

Everybody who has had any experience with elephants, whether used as baggage beasts, as timber-draggers, or for riding purposes, knows how greatly one individual differs from another in temperament. One is always willing to do an honest day's work, another will only do it at the expense of much goading and abuse from the mahout; one staunch, another variably in its moods; one plucky and another cowardly. We expect variability among weaker animals, but it is strange that it should be so extremely pronounced in such an animal as the elephant, which, in its wild state, fears no enemy that exists in the jungle and to whom, therefore, cowardliness must not be a natural instinct.

Assuming then that a wild elephant is fearless, and I think this may be assumed as a general rule, for although a wild elephant is always on the alert, and can usually be driven without very much difficulty, it is only by unwonted sights and sounds that this is done; the feeling of fear, resulting, subsequently in cowardliness, must be acquired during captivity; but when we come to analyze the different causes that make an elephant show the white feathers, we soon find that we have set ourselves a difficult task.

No elephant, I have ever ridden, has shown itself to be quite happy when the clatter of a pony's hoofs was heard at close

quarters behind it; most elephants are afraid of barking dogs; a railway or a steamer's whistle is a sound that few elephants can hear without bolting or attempting to bolt; some elephants will shy at dark shadows, some will refuse to go through mud six inches deep; some are gun shy, and the smell of blood is too much for others. I remember shooting a green pigeon off the back of a female elephant: as a rule, a thoroughly staunch beast from whose back tigers and bison had been shot, but when the mahout tried to make her pick up with her trunk the pigeon I had shot, no sooner had she touched it, than she trumpeted and bolted about 200 yards. The bird had just fluttered as the elephant touched it, and this movement, together with the smell of the pigeon's blood, had frightened an animal many thousand times its size. It may be added that when the mahout brought the elephant back and tried to enforce his original order, it first crushed the pigeon beneath one of its forefeet and then lifted it up and gave it to the mahout. To explain these various signs of fear, we must remember two things: first, that an elephant's eyesight is extremely poor; and secondly, that it was made captive by man, and since it has been captive it has always been under the control of man, and in man it recognizes its master. It is doubtful whether an elephant can see distinctly an object 15 yards away from it; in its natural condition this weakness of sight-power is practically no infirmity; for its great bodily strength, its keen sense of smell, and—to a somewhat less extent—its acute sense of hearing are quite sufficient to secure for its safety from all possible enemies (if we exclude man), and to enable it to procure an abundant supply of food. But when domesticated, this weakness of eyesight becomes an infirmity. To consider the instance I have given of an elephant bolting at the fluttering of a pigeon. In this case the elephant, directly at the command of its master, and, one must suppose, without in any way using its little brain power, attempted to do a thing which it had done many hundreds of times before with inanimate objects (caps, daos, ankas, &c.), but on touching the object with the extremely sensitive tip of its trunk, something occurred which, in former cases, it had not experienced, and the consequence of the unexpected movement of the object, combined doubtless with the smell of blood, and the absolute ignorance of what the object was, had made the animal afraid. 'A little knowledge is a dangerous thing'; the elephant knew what it was intended to do and how to do it; but the unwonted movement of the object to be picked up was more than its senses could instantly explain, and the consequence of the uncertainty was fear. And so it is with all other causes (with one exception) which induce elephants to show fear; they have become so used to rely upon their mahouts and to obey their orders, that when anything unusual occurs, for which their weak brain power does not at once offer an explanation, they are frightened. It may be the case that an elephant has been trained

and driven by weak mahout in whom it cannot feel confidence although it realizes that it is subject to the man; if this has been the case, exhibition of fear will probably be much more frequent, and the state of fear will be more lasting, as any encouraging words from the mahout will have but little effect.

The one exception, which I have remarked on, to fear being caused by unwonted sights and sounds, is that caused by the presence of a dog. This is not universal, but it certainly is a fact that most elephants dislike dogs. Nature accounts for the dislike, which amounts to fear, by saying that in their wild state, young elephants are sometimes hunted to death by wild dogs; but I have never myself met with, or heard from, an eye-witness of a case in which even a calf-elephant had been killed by wild dogs. I am inclined to think that the smell of a dog is offensive to elephants, and certainly this seems the more probable if there is any truth in the common idea among natives of many parts of India that wild dogs blind their prey by driving the hunted animals along paths upon the shrubs in which they have urinated (the urine containing some irritant capable of temporarily blinding as large an animal as a sambhur), for though an elephant's head is carried so high that it would not fear being blinded, the irritant property in the urine is offensive either to the elephant's sense of touch or smell.

In writing of the cowardliness of elephants, I have not directly referred to their so-called sagacity. Nuttall defines 'sagacious' as 'quick in thought or scent,' and if we accept this definition we must call an elephant sagacious, for no one who has been after wild elephants can deny their keenness of scent. But I do not think this kind of keenness in any animals but dogs is called sagacity, and in dogs it is only when combined with quickness of thought that a high degree of sagacity is obtained.

I do not consider an elephant sagacious as the generally accepted use of the word. It has always appeared to me to be the slowest in thought of all animals that are trained by man, and to be absolutely lacking in reasoning power. Its lack of sagacity, its complete subordination to its master and its cowardliness go hand in hand, and it is only when an elephant has been well trained that its absolute dependency on a good mahout is of advantage to it.

LONG TOM.

VI.—EXTRACTS, NOTES AND QUERIES.

The cause of decay in Plants, and the remedy to give to them new life.

BY R. R. HARDING, CURATOR, BOTANIC GARDENS, TOOWOOMBA, QUEENSLAND.

The primary object of this paper is to direct attention to the results of unskilful planting of trees. I will endeavour to show that this is very expensive and unsatisfactory in the end. When we consider that it takes only a little time longer to plant trees properly, the only excuse that can be given for not doing so is that the persons who plant trees or shrubs are afraid to separate the roots for fear of killing the plant. It would be, as a matter of fact, much better to kill it then than to be disappointed in after years. Such cases are numerous in this town, and I am often asked by residents here and by others in different parts of the colony, what is the reason for their trees looking so miserable?

Before I give a practical illustration of this, I will go back to the heading of this paper "The cause of decay in Plants." Decay or disease is the antithesis of health, and, as the health of the plant means the correct performance of its functions, disease may be defined to be an incorrect performance of those functions. I believe that of all the various kinds and forms of disease to which plants are liable, none are so general or so fatal as those affecting the roots. In many, perhaps in most cases, it is extremely difficult to say precisely where disease originates, and how it is produced. It is only when we see it in some of its intense forms of development that we are aware of its existence.

On the authority of the wisest of men there is nothing new under the sun. Yet there are constantly presented to us things that appear and are to us essentially new. Take the position of a tree. Its position may be said to be unchangeable; the soil, sub-soils, atmosphere and climate may be so far unvarying as to be also unchangeable. On the other hand, the roots of the tree are constantly year by year altering their position, traversing as it were the whole surrounding area in quest of food. Moisture also performs a very important part in the nourishment of the tree and all strata of soil penetrated by the roots are not equally full of moisture, so that when the roots pass through one stratum the tree is well nourished, and on passing through another it is less liberally supplied. Atmospheric influences also materially affect the tree, and as these vary so the growth varies. Insects, too, do occasional injury to trees by eating or poisoning their foliage, hence, as the foliage is good or healthy, or the reverse so is the growth of the tree, good or bad, for that or for succeeding years. The mellow, withered, or fallen leaf in early or midsummer is not

always a sure indication of a diseased tree; indeed, it is always more satisfactory to find an evergreen tree of any kind shed its leaves freely on agitating the tree than that they should tenaciously hold by the tree after they have become withered. The decay, or the dying of leaves in some instances, evidently depends on a want of vigour or on partial rot in the roots, but in a great majority of cases it is produced by injudicious planting and after cultivation. As an instance of this, I may state that last September I was requested to inspect the avenue of Camphors growing in the Royal Agricultural Show Grounds. For the past two or three years they had looked very sick, each year getting worse, and they would eventually die if something extraordinary were not soon done to them. Various causes have been assigned for the appearance of these trees by those who have expressed their views upon the subject, but there was no difference of opinion as to their highly unsatisfactory state. Like most other places of similar extent in this part of the Downs, it is evident that the land in the area is not all alike in its suitability for the growth of trees; yet, allowing for the difference, those conversant with tree-culture will not have long to seek for the cause of this decay, which has been slowly but surely going on. The decline is not the result of old age, nor of the capability of the soil to grow and maintain the trees in a healthy condition, for a closer inspection of similar trees growing only a few yards away, confirmed my first opinion, which was that want of timely thinning and the want of nourishment at the roots, caused by bad planting, were at the bottom of it all. The questions put to me were--"Could anything be done to the trees to give them new life? Was it advisable to plant young trees between them, and when these had made a start to then take the sick ones out?" The answer I gave was—"Leave them to me, with power to act, and they will be given new life." I remarked at the time these were planted that they would never make anything else but shrubs, and that only for a time. I examined the roots and foliage thoroughly, and found that three parts of the branches were dead or decaying and the foliage scant and yellow-tinted; but on examining the roots I saw at once the cause of all the evil. The trees, in the first instance, had been planted too high, the roots when young had not been spread out; they were simply growing as if they remained in a pot, and those who know the size of these Camphors will be surprised at my saying that the roots had not extended more than 6 feet from the stem of the tree, when they should have spread 12 feet at the least. The roots showed up out of the ground 2 feet from the trunk. They had embraced and interlocked each other and on account of the scant foliage, were exposed to the full rays of the sun, and the remark I made at the time of planting was now justified. My first work was to cut out the dead yellow branches, the centre of which was found to be decayed. Then all the inside branches were taken out, the surface of the soil under each tree was forked over very

shallow, and outside the spread of the foliage a trench was dug all around the tree. Now this, of course, is the proper place to apply the nourishment, at the mouth of any tree, as here are situated the extremities of the roots, and as these feeding-roots spread out beneath the soil pretty nearly to the same extent as the branches above ground, the tree should be fed at the distance of the extremity of the branches above ground from the stem. Here Nature teaches us the lesson: The head of the tree is in the form of a dome, like an umbrella; all around the soil is exposed to the rain. And the water penetrates the earth just where the extremities of the roots are situated to receive it. In addition to this, the greater part of the rain which has washed and refreshed the leaves trickles down from the ends of the branches and reaches the ground in the appropriate spot. In trenching around the trees *immediately where the branches extended, the men were surprised* to find no roots. This was nothing more than my practical experience expected, because, if there had been roots there would have been no necessity to do anything to the trees; but here was the mischief. The trees were then thoroughly mulched with half-rotten straw and manure, well covering up the large crinkled roots near the stem with a good coating of it. At the extremities, where the feeding-roots should have been in the trench, the richest manure was placed, but none was forked in. On the 17th March, the care-taker being present, we found that at the extremity of the trenching, and right up to within 3 feet of the stem, the young fibrous roots had formed a mat, and it was impossible to lift the mulching without damaging these roots. Now, what I wish to draw particular attention to is this: when the men started to fork over the surface they wanted to start near the stem. This I objected to at once, and made them keep their backs to it, showing them where the mistake is often made by digging underneath any tree or shrub. Each time you turn over the soil, so many rootlets suffer, because as you proceed you keep on doubling the roots over towards the stem, and this is carried on until the work is finished, when the soil is generally raked back again. Now this is against Nature; it is similar to some one doubling your fingers back upon the wrist and leaving them there. The roots are left in that state until the next season, and then the same cruel operation is carried out again, until the roots are diseased by being constantly bruised and broken, when, of course, the tree suffers and begins to decay. The proper way to clean underneath a tree is to start just at the extremity of branches, keeping your face to the opening until finished. You need not disturb the soil near the stem of a large tree, for do what you will there you cannot improve the growth of the tree; because all roots at that place cannot feed, being too large, but you can throw some of the soil from the first remove round the stem. If you want to prevent decay, feed them just as I have explained, that is, at the extremity of the feeding-roots, and that is just where the rain

trickles down from the leaves. A practical man can see immediately what is the matter with any tree that is sickly-looking; if the top of the tree is decaying it is the fault of the tap-root entering the cold wet ground, and the remedy for this is to excavate and cut the tap-root clean off. I say clean, for the least bruise will affect the tree's future growth. If the branches wither and the leaves fall off from the lower branches, it is because the surface-roots have been disturbed and doubled back in the way I have already described. There may be some other cause, but that is the chief one. As all plants in this Colony are surface-rooted, it is advisable not to disturb them by that process. If the rootlets require separating, the best way is to get a pointed pick and work from the stem by continuous drawing; this does no harm, and the few roots that are torn up are of advantage to the tree's growth; it separates the mats of roots and draws all towards the feeding point. There is no necessity to throw any soil back, get some mulching and cover all underneath the tree with a good coating. If you have any manure especially good, I have told you where to put it.

I know of one instance where the owner, wishing to prevent the roots of a Camphor tree from coming into a bed made around the stem, placed bricks and sheet iron close round the bottom with the object of preventing its roots coming through; but very soon they got beyond this confinement; they turned upwards and now the two feet of soil is a mass of fibrous roots, and the tree has splendid foliage.

There is no pursuit wherein so much depends upon the right thing being done at the right time. As in this and in all other pursuits the man of close observation and systematic habits, who is not too proud to learn from any sources, however humble, is the one who will succeed, for there is no better guide than to seek the advice and experience of others, and by following the advice tendered it will be the means of preventing decay, and will also give to the plants new life.—*Queensland Agricultural Journal.*

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A new Assam Timber Tree.

BY D. PRAIN, I.M.S., F.L.S., &c.

In October 1886, Mr. Barker, of the Forest Department, called attention to the existence of a tree which he was unable to identify, occurring at the foot of the hills in the North Lakhimpur district and known to the Assamese as the "Sia Nahor." He had submitted specimens for identification to the Forest School at Dehra Dun, but having received no definite reply he sent a flowering example to the Calcutta Herbarium. Mr. Barker's specimen was not a very good one; it sufficed, however, to show that while "Sia Nahor" belongs to the same natural order as the "Nahor" proper (*Guttiferæ*), it is not like "Nahor," a *Mesua* but a *Kayea*. The specimen sent was, as a matter of fact, tentatively referred to *Kayea floribunda*, a not uncommon tree in the lower hill forests of Sikkim, Bhootan, Khasia, Cachar and Lushai, known in Cachar and Sylhet as "Kurun" (*Wallich*) or "Kurul" (*G. Mann*). The flowers of Mr. Barker's specimen were, however, so much smaller than those of *Kayea floribunda*, that it was clear from the first that "Sia Nahor" was at least a distinct variety of "Kurul."

Nothing further was heard at Calcutta of Sia Nahor for thirteen years when, in December 1899, Mr. Young, Deputy Conservator, sent a set of specimens, this time in fruit, for identification. Mr. Young writes as follows:—"The tree is to be found on "the north bank only, and is most plentiful immediately under the "hills in the North Lakhimpur sub-division. This fact probably "accounts for its absence from Peal's list of Assam Timber trees, as "I understand his collection was confined to the south bank of "the Brahmaputra.

"The tree is large, with a straight bole 60 feet and more to "the first branches, bark grey, wood close-grained, hard and very "heavy. It is said to be very good for structural purposes, but "decays rapidly in contact with the soil."

An examination of Mr. Young's fruiting specimens made it clear that the Sia Nahor was not *Kayea floribunda*, but before preparing a formal description, fuller material was desirable. Mr. Young was accordingly asked to send flowering specimens to correspond with the fruiting ones already sent. With this request, Mr. Young very courteously complied in June 1900. These plainly showed that in "Sia Nahor" we have to deal with a hitherto undescribed species of *Kayea*. To make this absolutely certain, the material now available was submitted to Sir George King, who has kindly compared the specimens with those in the collection at Kew, and in confirming the view that the species has not before been described, has kindly undertaken the joint responsibility as to its name. A formal description of the tree is given below.

KAYEA ASSAMICA, *King and Prain*. A tall handsome glabrous tree, bark grey, wood hard, close-grained; young branches pale, slender, cylindric. *Leaves* opposite, firmly coriaceous, entire, ovate-lanceolate, base cuneate, apex shortly caudate-acuminate, nerves numerous, equal, slender, one-eighth of an inch apart, not prominent on either surface, upper surface somewhat shining, lower dull; length, 3·5—4·5 in.; width, 1·35—1·75 in.; petiole slender ·4 in. long. *Flowers*, in slender, terminal and axillary panicles, 3—6 in. long, branches of panicle short, slender glabrous, pedicels in flower very slender ·2 in. long, in fruit elongated and thickened, bracts and bracteoles at base of branchlets and pedicels 2 opposite small caducous. *Sepals* 4, imbricate, outer pair orbicular ·15 in. long, much enlarged in fruit, inner wide spathulate, apex rounded. *Petals* 4, shorter than sepals, suborbicular, ·1 in. long, thin, white. *Stamens* many, filaments free, capillary, longer than sepals; anthers globose. *Fruit* globose; covered by the thick accrescent calyx, tipped by the remains of the style, ·85 in. across. *Seed* solitary.

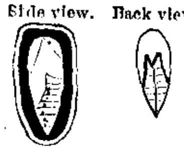
ASSAM; North Lakhimpur, near the foot of the hills, common, *Barker! Young!*

The species is most nearly allied to *Kayea floribunda* which, however, differs markedly in its much longer leaves, narrower for their width, with fewer more arching nerves which are much more prominent beneath; in its more copious racemes with larger flowers and in its much larger fruit which is 1·5—1·75 in. across.

Damage to Deodar Seedlings by the "cut-worm" (*Agrotis ypsilon*).

BY B. O. COVENTRY, I.F.S.

During the summer months of 1900, it was noticed *that* a considerable number of deodar seedlings from seed sown in December 1900, had withered in the nurseries at Gora Gali in the Rawalpindi *Division*. *It* was found that the withered seedlings had been cut through close to the ground and the upper portion



Earthen cocoon.

dragged down into the soil. By searching under the damaged seedlings an earth-coloured larva was found and identified as the "cut-worm" or *Agrotis ypsilon*, which is described and figured in Stebbing's book on the "Injurious Insects of Indian Forests."

A careful watch was kept over the nurseries, and as soon as a seedling was seen to have withered, search was made in the soil below it for the larva, and by collecting and destroying the larvæ in this manner, the damage in the nurseries was practically stopped. There is little doubt that had the larvæ not been caught and destroyed, a much larger number of seedlings would have been killed.

The larvæ pupate in the soil, forming a cocoon of fine particles of soil firmly cemented together. The pupa is about half an inch long and of a yellowish-red colour, the eyes and antennæ of the moth being distinctly prominent through the pupal case. Pupæ were obtained during the middle of July and a moth emerged in the middle of October.

The Burma Forest Bill, 1900.

By F. G.

The *Burma Gazette* of November 10th contains the draft of a new Forest Bill to supersede the Upper and Lower Burma Forest laws at present in force, and to cover the Shan States and the Chin Hills. The Bill differs considerably in its framing from the Indian Forest Act and from the Acts to be now superseded, but the treatment of the subject is in the main very similar. Some of the chief points of difference are indicated below.

Leave to introduce the Bill was to have been moved for on the 13th December 1900.

The Bill refers primarily to "Reserved Forests." There are no Protected Forests, the place of which is taken by *land at the disposal of Government* and by *public Forest land*. The former is defined as land over which *no person has acquired rights*, either permanently or by grant or lease. The latter is "land at the disposal of Government and not included in a reserved forest," and is a new invention. To a person unacquainted with Burma both definitions appear bad. Either there is no difference between "land at the disposal of Government" and "public forest land"; or "land at the disposal of Government" includes "reserved forest." But one great object of the Bill is to create reserves and unreserves, so that the term "land at the disposal of Government" requires the addition of the words "not included in a reserved forest." Again, it is understood that in the Burma "reserved forests" there are "rights created by grant or lease," as well as those created by "use," so that "reserved forests" may or may not be "land at the disposal of Government." To an outsider the two definitions are confused and unsatisfactory.

The Bill contains no provision for "Village forests," as it is stated that the experiment has been tried and failed badly in Thayetmyo and elsewhere. Another new definition is that of '*supermarking*,' which is "the unauthorised impression of a mark on timber already bearing an authorised mark legally affixed." The need for such a definition is not apparent. The question whether a fraudulent mark is placed on a log previously marked or not, appears to possess no practical interest whatever. The term "classification mark" is also new, and means "a mark placed on timber to denote its origin or the agency by which it has been handled." The term "property mark" again is new, and means "a mark placed on timber to denote that it belongs, or will, after all purchase-money or royalties due to Government shall have been paid, belong to the owner of the mark." It appears that the single term "timber mark" could equally well be made to cover both of these.

The constitution of reserved forests takes place much in the same way as provided in the Indian Forest Act. There is no Forest Settlement Court, but a Forest Officer may be appointed to assist the Forest Settlement Officer with his opinion. With respect to shifting cultivation, the Indian Act provides that the Forest Settlement Officer shall report on it separately and embody the orders of Government in his report. The Burma Bill allows him to settle the claim as he would any other claim, without a special reference. Although the Bill seems careful to call shifting cultivation no more than a *practice* which may be *permitted*, it omits to specifically deny that it is a *right*, and the word *right* is used in the marginal title to section 22. The Forest Settlement Officer is also given a new power, *viz.*, that of revising and altering his own awards at any time within a period of three months and prior to the final notification, provided that he goes through the procedure again, and provided that he cannot go behind anything that has received the sanction of Government, or has been carried into effect.

Shifting cultivation, unless expressly stated otherwise, may only be exercised by persons specially mentioned in the award. The Indian Act does not state what is to be done in the case of claims to a right of way or watercourse, beyond merely recording them. The Burma Bill enables the Forest Settlement Officer to decide on the merits of such claims, and distinguishes between "water" and "watercourse." He is not allowed to complete any transaction under the Land Acquisition Act without previous sanction, either as regards taking possession or making compensation. Both Acts allow Government the right to revise the proceedings of the Forest Settlement Officer before issuing a final notification.

The Burma Bill further enables Government within five years from the issue of any final notification, to re-open the whole matter or any part of it. The Indian Act allows nothing of the sort, but it has frequently happened that many years after a forest has been duly settled under section 34, a Government has taken upon itself

to say that the proceedings were not satisfactory, and ordered a new settlement. Such a course is probably illegal, but as the object has always been to increase privileges or rights, it has never been disputed. The Burma Bill further provides that Government may withdraw from any proposed reservation by notification in the *Gazette*, and thereby void the prohibition against clearing land, &c., which is entailed by the preliminary notification. The translation of a final notification, which, in India is published by the Forest Officer, is in Burma to be published by the Deputy Commissioner. The Bill further provides that rights to shifting cultivation, to pasture, or to produce, which are disused for five consecutive years, *may* be notified as extinct. Considering the pernicious nature of rights as compared with privileges, it is a pity that the extinction is merely permissive. The diversion of rights of way is allowed, provided that *another suitable way already exists or has been provided by the Forest Officer.* Why it cannot legally be provided by any other officer or landowner is a mystery, but the Indian Act is the same. The poisoning of water is forbidden by the Bill itself, but dynamiting is left to the possible rules.

Chapter III. is not very satisfactory. It apparently refers to unreserved forests, but the heading is "General protection, &c., of Forests and Forest produce." The marginal title of section 30 is '*Reserved trees in unsettled tracts*,' but the clause itself provides that all teak trees, *wherever situated*, &c., are royal trees, and that other kinds may be declared royal. Section 31 protects reserved trees. Section 32 declares that all manufactured catechu, timber, charcoal, &c., &c., whether from Government lands or *from other lands* may be made subject to royalty dues. Section 33 provides that *any person may use* the forest produce on "public forest land," except as may be reserved. It is hoped that this wording will diminish the opportunities of forest guards, but considering that no man may approach a Commissioner or a Tahsildar, or exercise any of his common rights without the usual douceur, the hope is sanguine. Nevertheless the wording is clear and good. Stone and lime are omitted from forest produce in these lands, and considered a revenue perquisite, which is an unnecessary complication considering that the forest suffers. The transit rules are modelled on those of India, but drift and waif is considered to be "in transit." There are to be "rafting stations" on the rivers, and all timber afloat below such station, unless in rafts under control, is "adrift." Apparently there can be no drift-wood above a rafting station, and none in a river without rafting stations, unless Government has notified the area. It is laid down that any suit following a Forest Officer's award as to drift-wood must be subject to the provisions of Section 424, Civil Procedure Code.

The arrest of forest offenders is only allowed if the offender refuses his name and address, or gives a false one, or is likely to abscond, as in Madras. Consequently offenders will have a good

time. An attachment mark may be placed on the *receptacle* of property attached. A convicted offender no longer shall be punish*ed*, but punish*able*, in various degrees; for trespassing, damaging by negligence, poisoning water, or breach of *Shikar* rules, up to Rs.50 or double, if the damage is more than Rs.25; for more serious offences, the Indian penalties. Section 57 provides that when fires are caused, &c., *by persons having rights*, the rights may be curtailed, but the recognition of common responsibility for common rights is absent. The refusal of assistance by persons bound to render it is made a forest offence punishable with one month or Rs.50 fine. The *stated* object of this is to do away with the need for recourse to the Indian Penal Code, so that the forest guard may be able there and then to arrest the person refusing and so convince the others of the expediency of rendering aid promptly. But it has been forgotten that such person can protect himself from arrest by simply mentioning his name and address. The offence certainly does become compoundable.

In both the Indian Act and the new Bill, the release of property under attachment when an offence is compounded is ill-provided for. Both laws allow property seized to be released only "on payment of the value thereof as estimated by such officer." If a guard seizes a cart and pair of bullocks employed to carry off a small log, the Forest Officer can compound the offence for, say, Rs 5, but he cannot legally release the cart and animals, unless he deliberately and falsely values them at a few annas which the offender must pay in addition. It cannot be the intention of the law, either that an officer should have to resort to such a subterfuge, or that a five-rupee offence should carry a hundred-rupee subsidiary penalty.

Section 65 provides that a convicting Court may not only punish the offender and order him to pay compensation in addition (as in the Indian Act), but fixes a limit of Rs.10 per tree or log. It goes further, and provides that unless the offender's employer can satisfy the Court of his non-complicity, the employer shall pay the compensation instead of the offender. The principle is good, it remains to be seen how the Courts will work it. A Forest Officer duly empowered may release property seized only if it is *not the property of Government.*

It may not be out of place here to draw attention to a serious flaw in the Indian Act. The *only* action which is an offence under the *law itself* (as distinguished from *Rules* which are seldom made) in a Protected Forest, is *setting fire to such forest*, the most serious offence possible (section 32 *d*). Yet section 63 forbids *any* arrest in Protected Forest, except for a contravention of some prohibition under section 29 *c*. Now section 29 *c*. allows Government to prohibit the removal of produce, the clearing of land, &c., but makes no mention of incendiarism. Consequently an incendiary can in nine cases out of ten set fire to a protected forest and laugh at the Forest Guard who catches him.

The Burma Bill makes no reference to the management of forests partly owned by *Government* (Section 79, Indian Forest Act), nor does it allow private owners to place their forests under State management (Section 38, Indian Forest Act), nor does it make *any provision for the* protection of mountains, river sources, &c., against erosion and disforestment (Sections 35 and 36, Indian Forest Act).

A Note on the Forests of Arrakan.

BY E. P. STEBBING, I.F.S., F.E.S.

Reasons for visiting Arrakan.—Having experienced considerable difficulty in working the Rules for the extraction of Forest produce in the Chittagong Division owing to the importation of unmarked timber and boats from the Arrakan forests, I last year paid a visit to the Deputy Commissioner of the Akyab District in Arrakan (Burma) in order to confer with him on the subject. The Akyab district adjoins the Chittagong one on its southern and south-eastern boundary.

I went down to Akyab by sea from Chittagong, returning by the inland route, and it was during this return journey and a trip up the Kolandyne River that I was able to make a few observations on the Arrakan Forests. Having to return to my own Division with all despatch, I had but three days at my disposal, and it is due to this and to the fact that I was unable to leave the main water channels and roads that my notes are far from being as complete as I should have liked. I am of opinion, however, that the following short history of these forests with which I have incorporated my own observations will not improbably prove interesting and may be the means of redirecting attention to their possibilities.

Previous Reports on the Arrakan Forests.—I was aware, previous to my visit, that there was no proper Forest conservancy in Arrakan, and my enquiries on the subject brought to my notice the fact that two reports had been written on the Arrakan Forests. The first was a Report on the Pyinkado Forests of Arrakan by Dr. Schlich, C.I.E., 1869, and the second a Report by Mr. Nisbet.* I propose to first glance at the reasons which led to these reports being written and then to summarise briefly the chief facts with which they deal.

Report on the Pyinkado Forests of Arrakan by Dr. Schlich.—The question of the desirability of taking some care of these Arrakan Forests had been under consideration so far back as 1856, in which year the Commissioner of Arrakan addressed the Principal Assistant to the Commissioner of Sandoway with reference

* *A copy of this Report has not been forthcoming although several attempts have been made to procure one.*

to an endeavour to prevent unauthorized fellings by private purchasers of the ironwood (Pyinkado) trees. This led (apparently) to the drawing up of a set of rules (dated 18th August 1863), which received the Government of India's approval. In August 1865, an amended set of rules was published. Trees under $4\frac{1}{2}$ feet girth were prohibited from being felled. Permits for felling were issued by the Deputy Commissioner, the price paid being Re.1 per tree. As an incentive to catch offenders half the fines realised from contravention of these rules were paid to informers.

These rules in their amended form were also passed by the Government of India.

In April 1868, the Conservator of Forests, British Burma, was informed that the Chief Commissioner had under his consideration the advisability of enquiring into the state of the Arrakan Forests, and Dr. Schlich, at that time Special Assistant Conservator, was deputed for the purpose and went down to Akyab, the capital town of Arrakan, to take up the work. The report that was the outcome of this enquiry refers chiefly to the Ironwood Forests of Arrakan and was compiled after a tour of inspection in the forests from the beginning of January to beginning of April 1869. The forests visited during this period were those situated between the Kolandyne River on the north and the Khwa khyoung to the south. The Pyinkado forests, however, mainly exist between the An khyoung River on the north and the Sandoway River on the south.

The report is divided into five sections :—

1st.—Description of Forests in Arrakan generally.

2nd.—Description of the Ironwood Forests.

3rd.—Present management.

4th —Proposed management.

5th.—Remarks on trees other than Ironwood.

These sections are chiefly summarised below :—

1st : Description of Forests in Arrakan generally.—Arrakan for topographical purposes may be divided into three belts, consisting of—

(*a*) The low lands bordering the seaboard and intersected with numerous creeks.

(*b*) A belt of rising land covered by the "dry forests."

(*c*) The hills (Arrakan Yoma) which are covered with evergreen forests.

(*a*) *The Mangrove Forests.*—In the seaboard belt grow in great profusion mangrove forests with other trees interspersed. It is also the seat of the paddy cultivation.

(*b*) *The Pyinkado or Ironwood Forests.*—The centre belt (*b*) is the one in which the Pyinkado or Ironwood forests chiefly flourish, although trees have been met with up to 1,000 feet elevation. In addition many other kinds of trees are found in this belt.

(c) *The Evergreen Forests of the Arrakan Yoma.*—In the mountain belt grow other varieties of trees, and Dr. Schlich mentions the curious fact that 'Eng' trees which in Pegu grow in the driest ground are here found in the midst of dense evergreen jungles. The forests in this belt include a most luxuriant growth of bamboos which is stated to extend over thousands of square miles.

2nd: *Description of the Ironwood Forests.*—The great mass of the Forests occupy a central position in the Province of Arrakan, which lies about north to south. This position may be roughly defined by a stream called the An khyoung on the north and the Sandoway River on the south. The length of the belt may be taken roughly at about 80 miles with a mean breadth of about 10 miles. North of the An khyoung up to the east bank of the Kolandyne, the trees rapidly diminish and are only met with in small patches. Dr. Schlich did not examine the country north of the Kolandyne (in which my own trip was made), but believed the forests there were similar to those on the eastern bank: south of the Sandoway River the forests rapidly disappear, though trees are met with at the Khwa khyoung, the southern boundary of the Province. Pyinkado is also found on the islands west of the seaboard.

As a whole, these forests were considered to produce timber of an inferior character, the shape and height of the trees not being good when compared to those of the Pegu Forests. In addition more hollow trees were found in the north than in the southern part of the tract. Their powers of reproduction are good, and they are not injured by jungle fires. Their great enemy was said to be the Toungya cultivation, and Dr. Schlich advised that this method of cultivating should be put a stop to. The timber was said to be limited in use, but in the five years, 1864—1868, 70,000 sleepers were exported for the East Indian Railway and 2,399 for the Eastern Bengal Railway. Dr. Schlich considered that in a few years it would be possible to export 50,000 sleepers annually. With reference to this estimate I have only been able to obtain information of the following export of sleepers from Arrakan since Dr. Schlich's Report was written. In 1876-77, Major Seaton reported that 10,000 sleepers from Arrakan sold in Calcutta at Rs.5 each whilst in 1884-85, 17,631 were sold at Rs.2-1-0 each. Further, I discovered that 60 tons of sleepers, valued at Rs.3,600 in the Customs returns, were imported into Chittagong from Akyab during 1899-1900. It would be most interesting to ascertain in how far this export of sleepers continues, and if it does so, the number exported annually and the revenue credited to Government on the transaction.

3rd: *Present Management.*—I have above mentioned that Rules were framed in 1866 for the extraction of Pyinkado,

Dr. Schlich states that the annual number of trees cut between 1864-65 and 1867-68 was only 3,624 exclusive of trees felled without authority. This he considered to be far below the natural capabilities of the forests, he having roughly estimated that there were four million Pyinkado trees in the Arrakan forests with a girth above 3 feet. Apparently the number of trees cut with authority at the present day is not very large, but an inspection of the area is necessary to show whether it is not probable (as, from what I saw taking place in the north of the Kolandyne River, I more than suspect to be the case) that the forests are being worked nearer to their capabilities than is imagined, and that merely to put money into the pockets of traders.

Dr. Schlich mentions that 'Thugyis' or native revenue collectors were placed in charge of the forests, and considered that such an arrangement was a faulty one. At the present day native township officers are in charge north of the Kolandyne and probably this is also the case in the forests to which Dr. Schlich alludes. As will be shown later on, this plan would not appear to be a successful one.

4th: Proposed Management.—Dr. Schlich, whilst being adverse to the reservation of the Arrakan Forests for the *present* (*i.e.*, 1869), advocated the following protective measures being introduced and enforced, an establishment being entertained for the purpose :—

1. Forests to be protected from unlawful cutting. This rule is certainly not enforced in the Forests to the north of the Kolandyne at the present day, and the Deputy Commissioner at Akyab himself told me that he considered a Forest Officer at Akyab would be useful to enable illicit cutting to be stopped and better supervision exercised.
2. From injury (wilful).
3. From Taungya cultivation.
4. From the granting away of waste lands in the forests.
5. From conflagration. I am not aware if this protection was extended to, and put in force in, the southern forests, but it is not exercised over the northern ones. In the latter part of March 1899, fires were to be seen both crowning the heights and encircling the hill sides, a sight which the Forest Officer knows well spells ruin to these forests. The establishment proposed to enforce the working of the Rules, consisted of—

1 Officer (a Senior Deputy Conservator).
2 Orderly peons.
2 Forest peons.
1 Office Clerk.
1 Office peon.
1 Depôt Clerk.
1 Burmese writer.
10 Goungways.

It was never entertained.

5th : Remarks on Trees other than Ironwood.—Little is said in the Report about trees other than Pyinkado. Dr. Schlich proposed that samples of various woods should be sent to Calcutta on trial.

I have extracted from the Report and given in Appendix A the list of trees noticed by Dr. Schlich as appearing in the forests he inspected.

Summarising Dr. Schlich's Report, it was held (in the Local Government Resolution thereon) that, on the whole, it did not appear that any special case had been made out for conserving the Arrakan Forests or for placing them under the Forest Department. I will take the reasons on which this conclusion was based in detail later on and will attempt to show how conditions have materially changed since this opinion was formed in 1870, thirty years ago. Personally I am of opinion that the change is so great as to warrant the deputation of a Forest Officer to examine the forests and reconsider the decisions arrived at in 1870.

(To be continued.)

V.-SHIKAR AND TRAVELS.

Adventures with a Bison.

I had often heard stories of people being charged by bison; but as so many men say it has never happened to them, and that really the bison is a most harmless creature, I thought the stories were "yarns"; but now I am wiser.

About a week ago, C. and I. started forth to try and slay a bull, of which there are a goodly number in the forests which I had to look after. I had been after them a great many times, but had only been able to get one, rather a poor one. Well, the first day, we came up to a herd, and after a lot of crawling (and this is not easy when you have to crawl with a double 8-bore, weighing 18lbs.) managed to see that there was a good bull in the herd. Here let me digress for a minute, to tell you that it is easy enough to shoot a bison, but to get a good bull out of a herd, requires an awful lot of stalking, as the confounded cows and young bulls always promenade about and offer such easy shots, at the same time getting right between you and the bull. Perhaps he, being boss of the show, gives them instructions to do it! Anyhow, it is very annoying of them, and in this particular instance they carried out my lord's orders to perfection, and C., whose shot it was, could not get more than a glimpse of him. After about half-an-hour's waiting, during which the cows—who saw, or smelt, that something was wrong—kept walking about and snorting at us: there was a loud snort and away they went. Well, I fear that I am not getting on very well with my yarn, but I am not used to "writing to the papers." Suffice it to say, that two people trudged most of that day without food or drink and never saw the bison again. But next day made up for the disappointment of the first.

We started off at some unearthly hour (about 3 A.M. I should think), and when we got out to the swamp, which is a favourite feeding-ground both of bison and elephants, we came on the tracks of a solitary bull. It was my shot this time, and after a very short track, one of the trusty jungle-men spotted master bison lying down about 5 yards off. I went up to the place, but could see nothing, for those confounded Kurumbers (jungle-men) can see in the dark, and while I was "fooling around," up he got; I caught sight of a great black mountain rushing away across my front; he was so near (about 6 yards) that I could not resist the temptation, and let drive. Snap-shooting when you have, the above-named 8-bore, loaded with 12 drams of powder, is foolishness, but by a lucky chance I hit the beast and knocked him over. In a minute he got up and went off. We waited a bit to give him time to die, as the track was covered with blood on both sides, which made us think he was very badly hit, and then we cautiously went after him, mounted on my *shikar* elephant, I in front

and C. behind. After about half-a-mile we came to a place where he had lain down, so making the Kurumbers walk behind the elephant, we went on. I suddenly caught sight of an ear moving behind a bush about 20 yards in front, and told the *mahout* to stop the elephant, as I wanted to put in a shot where I calculated his shoulder to be. One can't talk out loud to the elephant on these occasions, so the *mahout* touched him on the head. The idiot of an elephant (and really wasn't he an idiot not to see the bison, if I could see it ?) stopped and, imagining, I suppose, that we wanted to get off, promptly sat down. This proceeding was a bit too much for our friend the bison, who came charging out like an express train straight for us. You bet, the elephant got up sharp enough, and as soon as this operation was finished, I let drive as best I could. No effect; the bison came on and went full tilt into the elephant's forehead; what with the smoke and the elephant's swaying up and down, I could not see to shoot again at once. The bison naturally recoiled somewhat (most people would if they had charged an elephant), but he was not going to be put off, and promptly closed again. This time I was able to lean over the elephant's head, and pour the contents of the second barrel into the broad back of the bull. He subsided gracefully, and then (and thank goodness it wasn't sooner) the elephant turned tail, and bolted. It was a nasty place with a lot of dead bamboos sticking up, and one of these caught C. in the back and knocked him off, rifle, hat, and all. I was too much occupied with looking out for bamboos and trees, to pay much attention to C., but I knew he must have fallen rather nearer to the bull than was nice. Well, we managed to stop the elephant, and I ran back (nothing would induce the elephant to go back) expecting to find the bull executing a war-dance on the top of C., but luckily I found him and the Kurumbers all safe and sound. What was to be done now ? That was rather a ticklish question. We could hear the bull lying groaning where he had fallen, but I confess we both decidedly considered discretion the better part, as the beast was lying in the middle of a lot of fallen bamboos and long grass, and if he had tackled us at close quarters—well, we might be there now. However, he got up and moved slowly off. We followed at a respectful distance, and though I saw him again I could not get in a shot, and as it was getting pretty late, we decided to leave him to himself for the night. Next day, as we thought he must be dead, we sent the men to see, but far from being dead, he charged them twice, they skidding up trees.

Next day I came up to him, but he bolted before I got a shot, and it was only on the fourth day that I found him standing in some thick jungle, and was able to kill him.

Poor beast, he must have had a bad time of it for those four days, as he had eaten nothing and must have been in great pain, and I was real glad, both for his own sake and mine, that I managed to kill him.

He was a very big bull, standing 5 feet 11 inches at the shoulder (measure an ordinary English bull and see what that means), but he had not got a very big head. His horns measured 36 inches across the sweep, and were 19 inches round at the base. The points were very much worn; he had lost 3 teeth, and his hoofs were almost worn down to the bone, so he must have been a veteran, and no doubt a very grumpy old chap, too.

I am afraid I have spun this yarn out much longer than it ought to have been, and if it is very dry reading, well, you need not publish it.

Let me, however, give a small parting word of advice, and that is, that anyone who is likely to get any bison shooting when he comes out here, should not use a pop-gun. I believe if I had not had an 8-bore on this occasion, and that loaded with 12 drams of powder, I should not be inflicting this interminable yarn on the patience of your readers.

PHOREST DHOREY,

In the Cooper's Hill Magazine.

VI.—EXTRACTS, NOTES AND QUERIES.

A Glimpse of Forestry in the Himalayas.

If one can picture to himself a country something like the mountains of North Carolina, but with a forest growth more like that of the Adirondacks, and then place a glorious range of giant snow-peaks in the background, one can form a very good idea of the Himalayan foothills; at least of that part known as the "Jaunsar" * Division of the Dehra-Dun Conservancy, to which this very brief and rough account refers.

Strip the southern slopes of all tree growth, and the picture is still better; when the monsoon breaks in June of each year, the snows are quickly *melted away, and the soil is left at once to the* mercies of an Indian sun, which has remarkable powers of drying what little earth the snows and floods have left. The northerly slopes, however, are fairly well covered with conifers and broad-leaf species, both in pure and mixed woods, the trees running up to ten and twelve thousand feet in altitude.

Above and beyond the tree line lie the grand old snows, those snows from which the sacred rivers—Ganges, Jumna and Indus spring, in whose waters countless numbers of good Brahmans wash their sins away each day, and down whose streams a very business-like Forest Department floats its logs.

Here the summer climate is most delightful and the winter not at all severe. In fact, on the coldest days the sun has a way of being very tricky, and if you step out of the bungalow without a hat you will certainly pay for your carelessness in a very painful way.

* Jaunsar Division, School Circle, N.-W. P. and Oudh.

The forest organization is a most admirable one, the higher officers being men trained in the schools of Germany and France, while the subordinate positions are occupied by natives who have graduated or studied at the Royal Forest School in Dehra Dun. It must be said, however, that the majority of "natives" do not take to life in the jungle, but prefer positions in the towns and large cities; so that at times it is difficult to obtain good men.

Some Government forests are "reserved," that is held without any hindering "rights" or privileges of any kind, while others are "protected," or subject to grazing-rights and other ancient usages of the villagers.

As for the forests themselves, they consist principally of deodar, spruce, fir and pine. Among the conifers and various species of oak, both mixed with the former and forming pine woods in certain localities, by far the most valuable of all the timber trees is the deodar, which has a wood very much resembling our own cedar and which is used for many purposes, the chief use being that of railroad ties. On account of the remarkable powers of endurance which this wood possesses (due to the oil it contains), it is very valuable when a wood is required which must be placed in contact with the soil for a period of years.

Sylviculturally considered, the deodar is an easy tree to regenerate naturally, but each different locality must be treated in a different manner to insure success. On moist northerly slopes the species grow flourishingly under any condition of shade; but on the dry southerly slopes it almost invariably requires a nurse of some kind during youth. Blue pine fills this position most admirably, although, if not looked after, it will gradually suppress the deodar; but this danger is avoided by girdling the pine over large areas, whenever it has served its purpose, and threatens to kill out the more valuable species. It is an open question as to whether or not this girdling had been carried too far; in certain cases it certainly appears so; but if moderately applied, it is without doubt a great help to the forest's future value. All over the sunny southern slopes, little groups of deodar can be seen taking advantage of the shade of spruce, pine, oak, and even rhododendron, although the mother deodar may be a hundred yards away.

The oaks are found at almost all altitudes running up to nine thousand feet, and they can be naturally regenerated if the ground is not covered with a pestiferous little plant called "Strobilanthes," which, with its very dense and compact root system, entirely prevents the acorns from reaching the mineral soil. No oak is cut for timber, but the whole supply is used as firewood by the neighbouring garrisons; this is carried down the mountain trail on little hill ponies, each one of which is so loaded down that you see nothing but a pile of wood moving through the forest.

In all localities where grazing-rights prevail, the Forester is of course somewhat handicapped; this is especially true in forests

kept simply for "protection," such as those on steep slopes, which are preserved to prevent the *débris* of the hillside from being washed down on the fields of the valleys. Of course, if the seedlings are constantly destroyed by the cattle, the forest gradually thins out, and the rains rush down unimpeded over the hard trampled ground. In many places a very good system prevails of closing a certain area to grazing whenever regeneration is attempted; and as the natives are careful to obey the rules, the result is successful.

All along the foot of the hills one sees a vast amount of territory covered by so-called "raus," which are broad and very rocky stream beds, filled with water during the monsoons only; these eat their way, little by little each year, into the surrounding fields, and are gradually stealing away the farms.

In such an article as this, the subject of working-plans is somewhat too deep to touch upon, and it will be enough to say that the forests are managed on the selection system, only the annual growth being cut each year. This is arranged according to diameter classes and areas, all trees down to a fixed diameter standing on a certain number of acres being felled annually. Consideration is always given to the sylvicultural demands, however, and where these clash with question of present financial returns, preference is given to the former.

Working-plans are sanctioned for a period of twenty years and new ones are constantly being made. In this particular part of the Himalayas, extensive blocks, sometimes covering a whole slope, are taken in hand and every marketable tree down to a certain diameter is calipered, the area is determined from the excellent maps available and the necessary calculations follow. A splendid system of well-made trails covers the mountains, and wood is also taken out very economically and in great quantities by log railways, steep cables, dry shoots and flumes.

As in every other part of the world the great danger here to the forest crop is that of fire. Although the country is an exceedingly difficult one to handle, owing both to its configuration and the character and religious scruples of its inhabitants, such a system of fire protection has been gradually built up, that losses have been greatly reduced in late years. An officer in charge of a range looks upon it as a disgrace to himself if fire gets the best of him, and the forest is splendidly provided with a net-work of fire lines. These are cleared and burned over each year (sometimes two or three times a year), and during the dangerous season, from February to May, additional men are put to work in the woods in order to be on hand in case of emergencies. Villagers can be summoned at any time by the Forest Officer in charge. A most valuable thing, in case of an extensive fire, is a sketch map, showing simply the formation of the country, giving all streams, ridges, fire lines, roads, trails, clearings, houses, and in fact showing accurately all points of vantage from which a fire line can be fought.

A Forest Officer's life in the Himalayas is certainly a most interesting one; and, provided he is a hunter or botanist, a most enjoyable one. In this corner of the world he must be content to live a life of solitude, as he is often off for many weeks together and sees no single white face. But this does not infer that he is uncomfortable; for an army of servants is always by him, and he lives in comparative luxury the year through. Besides, the hills, the trees, the tigers and deer are very good companions after all.—F. E. OLMSTED in *The Forester*.

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Rotation and Possibility in Selection Forest.

By F. Gleadow, I.F.S., F.R M.S.

In the *Revue des Eaux et Forêts* for October 1st, 1900, that grand old Forester of France, M. Ch. Broilliard, has a thoughtful and interesting article which required and deserves a second reading. Starting from the idea that the term *rotation* is at bottom no better than a misnomer when applied to the Selection method, he goes on to recommend the abolition of the possibility by volume, with its endless countings and calculations, in favour of a simple possibility by area and number of trees. It is very possible that I have not grasped his full and precise meaning, *though I got my original knowledge and love of the work from* him, and hope to go on getting more. Still I will do what I can, and try not to misrepresent him. The term *rotation* then (*revolution*) is a misnomer when used in Selection methods. A forester who had never seen or heard of anything but Selection forests could not have discovered or invented it, for he would have no idea to base it upon. The word and the idea are founded upon coppice working and clear fellings in which the word represents an actual fact. Indeed, Indian foresters no longer use the word *rotation* in Selection. We have the "exploitable age" which is divided into "felling cycles." But even the term "exploitable age" is a fiction. At each felling in practice we cut trees of *all ages and sizes*, trees that have reached the top class, and also trees that would never reach it if they stood till Doomsday. We do not know the age of a single one of these trees. Some of the biggest may be well under the theoretical age, some of the small ones may be long past it, according to the conditions under which they have grown. Good sylviculture is the great object, not a rigid adherence to a given age or size. M. Broilliard

quotes from his personal experience some excellent examples of this. In 1891, there was seen at St. Dié an immense fir stump showing that the tree had lived more than 100 years under cover before attaining its freedom.

In 1893, in the forest of Etival, there was felled a fir of 95 c.m. diameter, aged 300 years. At 150 years old it was only 8 inches thick, and so on. Parenthetically, it may be of interest here, though irrelevant, to mention that the Dehra Dun Forest School possesses a round of deodar which is (as roughly recollected) about 7 feet diameter and 700 years old, though it never suffered much from suppression. To resume, what is the rotation? Is it the mean age, or the usual age of a tree of given size? On the one hand, it is impossible for the greater part of the trees to attain this given size. On the other hand, it may be a pity to fell some trees that have attained the given size but are still prospering, and their age may vary as 1 is to 2. In the Selection fir forest, there is neither mean size nor mean age, and the term rotation is consequently incomprehensible except by analogy with some other method, such as that of *regular* high forest.

The use of a possibility by volume, always uncertain and variable, leads continually to new valuations and regulations.

Before each return of the fellings, new countings and estimations have to be gone through, the trees are being constantly subjected to the clawings and blazes of the measurers, and the young stock is not improved by so much going to and fro in it. From a cultural point of view, the drawback to the possibility by volume is its concentration. With a six-year period, the coupe should cover one-sixth of the area, but nine times out of ten it will be condensed into one-twentieth. Hence results too strong a felling, followed by too long a period of neglect, and general irregularity. So long as there is no fixed limit of area, for example, 4 to 6 *trees per acre*, the fellings will not extend over that *area* which is necessary to make a good *cultural* operation. It is really the possibility by volume which has led to disparagement of the Selection method of treating fir forests. Every method of treatment has its appropriate manner of realising the possibility, and if other ways are adopted, the result generally leads to disparagement.

M. Broilliard advocates a possibility limited by *area* even in the Regular method, and as many foresters fail to understand exactly what is meant, he defines it as fixing the compartment over the whole of which the coupe should extend, and laying down the "chiffre d' abatage" which, I gather, means the *proportionate severity* of the felling. Would it not do to fix the area to be revisited, say, every five years? Not so, for at each visit trees might be cut with too great freedom so long as there were any left that could be cut, to the great danger of the regeneration. The *order* of the coupes would be fixed, but not their amount. The possibility would not be truly fixed. The standards over coppice

are in somewhat similar case, and have been quoted as an instance of elasticity in treatment which gives generally fair satisfaction. But M. Broilliard quotes a grumble of the Pont à Mousson people, "so long as we are in the coupes marked by Mr. Jones, we shall get no revenues;" Mr. Jones having given their fathers too much, and reserved too little for the children. He was an exception, but such *exceptions* are *liable* to become common in countries like India, where an officer's work is judged by his revenue. The possibility by area in regular high forest would of course lead to variations of the revenue, but the "sustained yield" is a chimera, a counsel of perfection which we are always striving after and never attaining. Even with a possibility by volume, though the yield may be kept fairly constant in quantity for some years, there comes the inevitable revision, and a different yield is laid down for the next period. And even if quantities remain constant, prices do not, so we may as well submit to the inevitable and allow a possibility limited by area to gradually equate itself, which it will do in time if the sylviculture is sound. How then are we to *regulate* the *possibility* in a regular high forest, where all the exploitable material is to be removed by several fellings in due order? Not by the number of trees to be reserved, since that number will vary from one coupe to the next, and from one compartment to another. Still less by volume, which will also differ from one compartment to the next, and is also incompatible with fixed coupe boundaries, and due order in the fellings, and good cultural work. The *proportionate felling* alone can satisfy the four necessary conditions: *quantity*, *area*, *order*, *sylviculture*. Thus, if the matter in hand is a forest of mixed oak and beech, fell one oak out of four, one beech out of three. The *quantity* will result from the crop itself, the whole compartment will be worked over, the dates and order of felling are regular, and the sylviculture is as good as the officer knows how to make it. This last remark about sylviculture must not be misunderstood. The officer who would stretch his revenue at the expense of his sylviculture may, if he likes, cut three or four oaks in one place, but he is bound by the rule, "one oak out of four" in the total, and must remember that if he gives way to greed in one place, he will have to leave too many oaks in another, and will gain nothing but discredit for doing bad and irregular work. In cutting one oak out of four, moreover, he may not take the most valuable for no other reason. He is bound by his sylvicultural honour to take the worst first if there are any bad ones, so that the state of the forest should go on improving as it never would under a possibility by volume, although in this case, too, the question of sylvicultural honour comes in. If any subsidiary operations prior to the fellings, such as breaking up the soil surface, are necessary in a given locality, the date and area of the felling being fixed beforehand, also fix the date and area of such operations.

I have more than once been astonished to hear that the Selection method was looked on by the French as a barbarous method, that being quite counter to my own experience. It is Judeich, the Great German Professor, who is responsible. Cotta before him had recognised that the simplest methods of determining the possibility are the best, but he got no further. Judeich denied to Selection the status of a method at all, since its possibility was incapable of being prescribed. But then he was thinking of nothing but *volume*. The Americans are nothing if not original. They seem to be tending towards a *possibility* by *Sawyer's work*, "Board measure," from which may the Fates preserve us.

I wish some of our good comrades would work up and let us have their ideas on the above (or any other) subject. There are plenty of good men and true, if Government would only hurry up with that notification forbidding the use of long chairs.

On "Leaf Fires."

BY O. C.

When reading of the results of Fire Conservancy Operations in Indian Forests, with what sad frequency we meet with the assurance that little damage was done to the growing stock owing to the absence of grass and other dense undergrowth; the term "leaf fire" is considered to be an appropriate description of the nature of the conflagration.

In Burma, and even in other Provinces reckoned to be more advanced in forest management, the forester often goes a step further and questions the utility of expensive fire-protection on the ground that where the undergrowth is sparse, the small damage caused by the annual fires does not justify the outlay necessary to ensure success in preventing them.

I have had opportunities of enquiring into these matters, and find that the assertion that "leaf fires" cause little damage is unworthy of acceptance and that consequently the deduction from this assertion is a fallacy, all the more dangerous where in a comparatively new department the subordinate service is taking its ideas and tone from the controlling staff.

It must at least be admitted that the seedling growth is interrupted by any fire, of whatever intensity, that may sweep over a forest area. Such an admission would in itself sufficiently justify an outlay on protective measures, unless necessarily utterly disproportionate to the present or future value of the forest; for any check to the progress of natural regeneration must be more or less serious when the progress and finally even the continuance of the forest is dependant on reproduction by this method. Unfortunately, however, the injury caused by "leaf fires" is more

far-reaching. The intensity of the flames, though it may be comparatively small, is sufficient to so injure the base of the tree that, besides creating a predisposition to disease, permanent distortions result in the growth of the younger age classes which will ultimately materially lessen the value of the mature stems.

It is not attempted to deny that much more injury is caused by those forest fires where the flames blacken the standing stems up to 20 or more feet in height; on such occasions, no doubt, many trees, which in a "leaf fire" would be only injured, are annihilated. But it is surely time to sound a note of warning to the forester not to take for granted that the injury visible immediately after the passing of a fire is all that need be considered, when in fact the most serious effects are those which, *in after years,* become apparent. It is surely time, too, that we should once for all accept the fact that any fire in a forest is a disaster, and that if an area is worth retaining as a forest, it is also worth while to pay an adequate premium for insuring it against accidents.

I have just passed through a promising young timber forest of teak, *Dipterocarpus*, *Terminalia* and other species, where practically every stem of this immature crop is seriously injured by "leaf fires," which have hardly even blackened the trunks, and thus the well-being of the standing stock and the future of the forest as a whole has been seriously endangered. Unhappily, too, the area contains vast numbers of flowering clumps of the male bamboo, with stems up to 10 inches in girth and 30 feet in height. The period for the annual fires will soon be approaching, and it appears probable that after these have passed a very large percentage of the already weakened standing crop will be killed out, and the type of forest completely altered, a result which will be largely due to the persistency of "leaf fires," which do so "little damage."

Caoutchouc Plantations in Assam.

By W. R. Fisher, B.A., I.F.S.

I see in the report on the caoutchouc plantations in Assam, a statement that the Bomani Hill plantation yielded 9·5 lb. of clean rubber per acre, and that the Charduar plantation yielded 9·4 lb., there being 92 trees per acre on the Bomani Hill and 14 per acre on the Charduar. Mr. McKee remarks that this proves that a densely-planted area does not yield more rubber than one sparsely planted, while it must have cost more to plant out originally and to establish as a going concern.

I chose the site for both these plantations in 1873-74, and managed them for about two years. In the Charduar plantation, lines forty feet wide were cut one hundred feet apart in dense evergreen forest, full of cane breaks, large Ficus trees and other difficulties. Colonel Keating, the Chief Commissioner of Assam,

was struck at the waste of timber, this involved and the great expense of clearing the line, and directed that an experimental plantation should be made on grass land near the Brahmaputra River. Mr. Mann, the Conservator of Forests, considered that trees grown on grass land would not yield anything like the same supply of caoutchouc, as trees grown in the humid air of the evergreen forest, and his opinion was based on the fact, that some large trees that had been tapped in Tejpur yielded very little rubber. The plantation on grass land at Bomani Hill was therefore limited to a small experimental area. The expenditure on it, however, was a mere fraction of the cost of the Charduar plantation, as far as I remember, and it would be interesting if the Assam Forest Department were to publish figures showing the comparative cost of the two plantations per acre, *now that it has* been proved that they return an equal yield per acre.

If grass land plantation like that at Bomani Hill will afford as good a yield as the forest land plantations in Charduar, a great future may be predicted for rubber-planting in Assam, and there are, or were in my time, enormous areas of waste grass land in that Province.

Flowering of the Bamboo in the C. P.

By A. Smythies, B.A., I.F.S.

A somewhat remarkable event is taking place in the Chanda district of the Central Provinces, and that is the flowering on a large scale of the ordinary bamboo (*Dendrocalamus strictus*). The area over which the flowering extends is estimated at 1,200 square miles, and in this area, although a few clumps here and there have escaped, the phenomenon is universal. But the extraordinary point about it is that clumps of all ages are flowering—not only mature clumps but quite slender seedlings of six or seven years' growth, or even less. I send you some specimens to illustrate this; the rhizomes show that those clumps are quite young. Last year the droughts affected the bamboos in the Dhaba Range of this district, and the bamboo flowered over a small area, and produced a kind of manna, which was described in the Forester (Vol. XXVI., page 363). Many thousands of people were kept alive for some weeks on the seed. This year the area is infinitely larger, and the whole population will, in course of time, flock to the forests to gather the seed.

The consequences to the people in the vicinity of this flowering and subsequent death of the bamboo will be rather serious, as for many years to come, they will not be able to find sufficient stores to satisfy the numerous wants of the agricultural population to the north and west of Chanda—at any rate, the price of bamboos will be very much higher.

The Government revenue which now amounts to about Rs.20,000 from this source will also suffer, as, when the dead bamboos have been utilized, there will be no more available for some 15 years or so. It would be interesting to ascertain whether such a universal flowering of this particular species has been recorded before. Needless to say, the oldest inhabitant has no recollection of such an event, and the flowering of the smallest clumps is believed to be unique.

It is probable that in this district at least, the bamboo does flower gregariously over fairly large areas, as three of the eldest inhabitants informed me that they had seen the bamboo flower twice: first, when they were about 10 years old. Their ages were probably quite 70. Hence it is not unlikely that this bamboo flowers at intervals of about 30 years.

[*We would refer our readers to Volume XXV.* (1899) *of the "Indian Forester," pages* 1—25, *and* 305, 306.—*Hon. Ed.*]

The Forests of Arrakan, Burma.*

BY E. P. STEBBING, I.F.S., F.E.S.

Discussion with the Deputy Commissioner, Arrakan district, on the present method of working the Forests.

At the commencement of this article I stated that my visit to Akyab was made in connection with the working of the Chittagong Division in Bengal. The Division is chiefly a water one; the forest produce is floated down the rivers and the royalty is realized at tcll stations, situated on the banks of the waterways, the timber being at the same time marked with the Government hammers. Soon after my arrival I discovered that a large quantity of unmarked timber and boats (dugouts) existed in the district, and the answer generally forthcoming to my enquiries as to the reason for the absence of the Government marks was, that the timber or boats in question had been brought up from the Arrakan districts, either direct by sea or along the sea face for a portion of the route and then through the numerous tidal channels which intersect all the southern portion of the district. The result of this presence of unmarked wood, &c., in the Chittagong district, greatly increased the difficulty of working the forests and checking the timber and boats brought out, and in order to understand exactly what arrangements were in force in Arrakan, I determined on my visit to the Deputy Commissioner.

A conference with him showed that the arrangements for collecting revenue on the Arrakan timber were very slight, a sum of Rs.4,000 odd representing the total annual revenue from the forests of his district. The Deputy Commissioner informed me that the timber was sold standing in the forest at Rs.3 per ton, provided the amount was paid before cutting and extracting the

* Begun in February Number, 1901.

wood. Failing this prior payment, Rs.5 per ton was charged. Passes were issued either by the Deputy Commissioner himself or by the Township Magistrates. *The timber was not, however, marked in any way* before being taken out of the forest or subsequent to its removal. This produced my difficulty in Chittagong. The Deputy Commissioner informed me in answer to a question that he was not aware that boats (dugouts) were exported from his district. Jarool boats (jarool is the best timber of Chittagong) are, however, numerous in my district and they came from Arrakan, their preparation from the forests in the Chittagong Division being prohibited owing to the enormous waste their construction entails. He further informed that there was no regular system of management in force for the Arrakan forests, and that he did not see his way to introducing one at present. He thought it probable that his forest areas were large, but he did not know exactly what timber they contained. His annual revenue from them was roughly Rs.4,000. In 1869, Dr. Schlich remarks that the revenue from the Arrakan forests, as a whole, had never reached Rs.5,000. In this connection I may mention that some merchants in Akyab informed me that they were being supplied with jarool in Akyab at Rs.50 per ton. I gathered from enquiries I made that the forests in the north of the district abounded in jarool, and as I shall show this statement is borne out by the fact that the wood is at present largely exported from here.

Description of the Northern Arrakan Forests.

I will now state shortly my impressions of the Northern Arrakan forests I passed through on my return to Chittagong, and will then, after touching on the export of timber from these forests, detail my reasons; for the opinion I have formed that a reconsideration of the advisability of the reservation of the Arrakan forests, as a whole, seems to be justifiable.

The forests north of the Kolandyne River resemble those lying to the south of the river, which were reported on by Dr. Schlich, in that they may be divided into three belts.

I.—The Mangrove Forests.

The mangrove forests comprise the low-lying swamp forests on the sea-board.

II.—The Dry Forests.

The dry forests are those situated on the rising ground immediately adjacent to the swamp forests.

III.—The Evergreen Forests.

The evergreen forests situated in the mountain belt.

These forests, I can dismiss in a few words as I saw nothing of them except from a distance. It was evident that the Toungya cultivation was largely carried out within their area, numerous burnt patches in the day time and fires at night being visible.

I.—The Mangrove Forests: *(a) Description.*

These forests are situated on the low ground running along the coast line of the Arrakan district and on the islands and banks of the rivers up to the point when they leave the hills and

also on the banks and churs in the network of canals which intersect the western side of the district. I noted that these islands filled the Kolandyne for some 50 miles upwards from its mouth and were clothed with the mangrove jungle, amongst which I noticed kripa (*Lumnitzera racemosa*), which is common in Chittagong. The sundri (*Heriticra littoralis or fomes*), common in the Sundarbans Division, is, I believe, also fairly abundant in these forests, but I am unable to personally vouch for this.

During my trip from Akyab north to Bothedong, I went through numerous kals and into and up the Méyu River, and I noted that the mangrove jungle was abundant everywhere. I also observed that the edges of the banks of the canals were fringed with a single line of the palm (*Nipa fruticans*) so plentiful in the Sundarbans (Bengal), where it is known as Golpatha. The palms are planted in this position, the leaves being used by the poorer classes for roofing their dwellings, instead of the sunn grass, in almost universal use (where not replaced by corrugated zinc roofing) in the Chittagong district.

The same predominance of mangrove jungle is to be observed on the banks of, and on the churs situated in, the Naf Estuary, the river which separates the southern portion of the Chittagong district from Burma (Arrakan).

This Sundarbans forest generally reaches about 50 feet in height, consisting of a mixed forest containing trees of all ages. The growth is very dense, aerial roots being numerous and rendering progression through the forest extremely difficult. Among the trees recognisable, I noted kripa (*Lumnitzera racemosa*), goa(?) gattea (*Periops candolliana*), sundri (*Heriticra littoralis or fomes*).

(*b*) Present management.

At present no revenue appears to be collected from these mangrove forests, perhaps owing to the small population and the great abundance of the jungle. I was told that the firewood used in Akyab itself was brought up from forests situated some distance to the south-east in the next district. If this is so, I do not understand the reason, as firewood is abundant at its very door.

(*c*) Future management.

For the present, at any rate, there would not appear to be a great demand for fuel from these forests, and a more detailed inspection will not improbably show that their reservation is not at present necessary, save perhaps of areas round the larger towns where firewood is being cut.

II.—The Dry Forests: (*a*) Description.

These forests, as already mentioned, are situated on the dry ground immediately adjacent to the mangrove forests forming a belt between these latter and the evergreen forests. The woods are mixed uneven-aged, virgin ones, and appear to be well stocked where untouched by heavy fellings and toungya cultivation. An inspection, however cursorily made, shows, however, that this latter is doing irreparable damage and that areas clothed

with fine forest are rapidly being denuded, the woods being replaced by a useless scrub-jungle. That the former—the heavy fellings—are also seriously impairing the forests I will show later on.

The dry forests are the home of the Pyinkado where found in Arrakan. Dr. Schlich, in his report, stated that he did not visit the forests situated to the north of the Kolandyne River, but believed them to be similar in character to those on the eastern bank. I am able to corroborate his statement that the tree exists in these northern forests, but my time was too limited to enable me to ascertain whether it was abundant or otherwise.

In addition to the Pyinkado, and at present holding a position of as great, if not of greater, importance in the forests of this portion of Arrakan, are three trees, jarool (*Lagerstömia Reginæ*), khoira (*Acacia catechu*), and garjan (*Dipterocarpus turbinatus*). They are all good timber trees, and in the last few years their wood has obtained a marketable value owing to a greater demand. I was informed that these trees are to be found fairly abundantly over this area, and from the export operations at present taking place I should think that this statement is probably correct.

Many of the other trees mentioned in Appendix A are to be found in these forests, but their importance is, I believe, at present small, although there is some demand.

(*b*) Present management.

In my interview with the Deputy Commissioner at Akyab referred to above, I have already mentioned the method on which these forests are worked, adequate supervision with the available staff being impracticable. The sale of the timber would appear to be practically in the hands of the Township Magistrates. As far back as 1870, Dr. Schlich stated that he thought this state of things should be discontinued, and the following would seem to show that the time has arrived when these forests should be relegated to the management of the Department.

I have said that a demand has arisen for the three timber trees, jarool, khoira and garjan, and my enquiries have shown me that heavy fellings of these trees are being made in the forests in the north of Arrakan immediately to the south of the Teknaf Estuary. How far such cuttings may be going on in other parts my inspection was too limited to enable me to ascertain. At the present moment there are at least two places on the Naf Estuary from which timber of the above kinds is being exported in large quantities, both in brigs and large native "balam" boats. These places are Maungdaw and the Prooma Kal. There is or was a very fine forest round these places, and it is rapidly being cut out and ruined by the heavy fellings at present being made in it. It has been already mentioned that on payment of a royalty of Rs.3 per ton a pass is made out for the intending trader who then proceeds into the forest and cuts what he likes. Under this pass the wood has, I understand, to be measured up in the forest before it is taken out, and the purchaser must give notice to the Examining

Officer when he has cut the amount of timber he has paid royalty for. Now the royalty actually realized by Government is very small, and out of all proportion to the amount of timber that is being taken out; at least this is the opinion my short inspection and subsequent enquiries have led me to hold. The balance of the timber is therefore removed illicitly, and the following is one of the methods in which this is done:—A trader takes out a pass for a certain amount of timber, we will say 100 tons, and goes into the forest to fell it. Once here he cuts as much as he possibly can within the time, but only presents for examination at the end of the period the 100 tons he has paid royalty on. Before asking for this inspection, however, he removes the extra timber cut, the paucity of the staff rendering this illicit removal an easy matter.

The trees are either converted into dugouts *in situ* after being filled or cut up in the forest or just outside, into beams, planks, posts, scantlings, &c., and quantities of these are to be seen at Maungdaw and the Prooma Kal. They are exported in this form. That this trade in Arrakan timber is assuming some importance is further borne out by the fact that large advances are now made to sawyers who live on the Moiskal Island, situated off the coast in the south-west of the Chittagong district, and these men go down and spend the cold weather felling in the Arrakan forests.

(*e*) Future management.

It is hardly necessary here to make any remarks as to the future management of these forests. A careful examination of them, based on the *knowledge that the conditions of environment, &c., as existing* in 1870, have considerably changed, is required, and it is with this object in view that the present note has been written.

(*To be continued.*)

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Report on the Teak Trade of Chiengmai, Siam.*

By Mr. Acting-Consul J. Stewart Black.

Exports to Burma.

The exports to Burma for the year 1899 amount to 175,444*l.* as compared with 252,837*l.*, a decrease of 77,393*l.* This decrease is chiefly accounted for by the smaller deliveries of teak from the Siamese Salween district to Moulmein.

Teak.

The value of teak worked out from this district amounts on an average to about half the total exports.

Output compared with 1898.

In 1899, 17,824 cubic tons, valued at 79,314*l.*, passed the duty station at Kado. The corresponding figures for 1898 were 26,479 cubic tons, valued at 100,657*l.* On the Bangkok side the output amounted to 86,336 logs of all sizes, or, roughly speaking, 25,326 cubic tons, valued at 96,250*l.*, slightly less than the output of 1898, valued at 100,000*l.* The total output of teak, therefore, from Northern Siam during the year 1899 was 53,150 cubic tons, valued at 175,564*l.*, showing a decrease of about 25,000*l.*

Output for last ten years.

For the purposes of comparison a statement showing the total output on the Bangkok and Moulmein sides, respectively, during the last ten years, is added. The statistics as regards Bangkok are not official as, previous to the advent of the Royal Siamese Forest Department in 1896, no official returns were available. They are, however,

* Diplomatic and Consular Reports, Siam. Trade of Chiengmai, No. 2518, Foreign Office, August 1900. Printed by Harrison and Sons, St. Martin's Lane, London. Price—One Penny.

the estimates of timber traders, and are substantially correct. Only full-sized logs are given, and the figures are for the floating season which begins with the rains in May and ends in the beginning of the following year in February or March according to the state of the water in the rivers. The under-sized timber sent to Bangkok has little influence on the export trade to Europe, as it is used locally. The Moulmein figures have been obtained from the returns published by the Government of Burma, and are for the months ending December in each year. The returns include logs of all sizes, the figures for full-sized logs not being obtainable here.

Statement of the Output of Teak from Northern Siam for the ten years 1890-99 (inclusive.)

Year.		*To Bangkok* (Full-sized Logs).	*To Moulmein* (All Sizes).
1890	Number ...	31,000	62,117
1891	" ...	11,000	43,873
1892	" ...	72,000	63,670
1893	" ...	73,000	52,463
1894	" ...	72,000	... *
1895	" ...	65,000	55,935
1896	" ...	59,000	47,[illegible]32
1897	" ...	31,000	62,717
1898	Cubic tons ...	76,000	26,479
1899	" ...	53,000	17,874

Cause of decrease in 1899.

The decrease in 1899 is due to the deficiency in rainfall during the past three years. In 1897, the rainfall amounted to 41½ inches, in 1898, 42½ inches, and in 1899 less than 40 inches. In 1893, when the last very heavy rain occurred, a total of 73 inches was registered. This deficient rainfall resulted in a very poor floating season, and this was particularly the case as regards the River Me Ping and its tributaries (the Chiengmai side). Only a few logs from this district got through to Bangkok in the course of the year. No logs at all came out to the main river from many of the tributaries, and in some instances logs put into the streams early in the rains never moved at all. The River Me Ping was unusually low during the year, and at the height of the dry season there was said to be less water in the bed of the stream than has been seen for fourteen or fifteen years. The last arrival of timber at the duty station at Paknampho was in the week ending February 10th. In the previous season the last arrival was in the week ending February 10th, whilst the date of last arrivals during the twelve years before that has varied from January 20th to March 17th.

* No return.

Prospects for next year.

In consequence of timber not moving during 1899 for want of water, the result is that if the rains for 1900 are only moderately heavy, the arrivals will exceed that of any other season. Over 20,000 logs are lying in the main stream well on their way to the duty station; whilst in the upper stretches of the river, there are also large quantities of timber which should, with fair average rains, reach the duty station this season. It has been predicted by weather prophets—it must be added, interested weather prophets—that the rains of 1900 will rival those of 1893 when 73 inches fell, and that the output of teak will not only beat all records but prove too large even for exporters. It is possible that the rains may be usually heavy, though the only basis for prediction seems to be the fact, that seven years have elapsed with less than average rainfall. The rains up to the present (end of June) have not exceeded those of the previous seven years, but it is during August and September that the greatest fall may be expected. One or two good floating seasons will just at this time make a great difference in the finances of all engaged in the teak business. Most of the present leases lapse in 1901 and 1902, and there is a clause which provides that timber still lying within the boundaries of the forest on the expiry of the lease becomes the property of the lessor. The lessor is nominally one or other of the local authorities, but, practically, the Siamese Government as the nominal lessor or forest owner is not allowed any voice in the matter of the disposal of the timber or the forests. An immense quantity of timber is now in the process of extraction, and should the seasons remain persistently bad till 1902, British companies and British traders will incur heavy losses. In some forests it takes quite three years to work the timber out, and as leases have been granted for a period of six years only, the margin for bad seasons is not very large. As may be well understood, the rainfall is, therefore, one of the great factors for good or evil in business in this part of the world, and the numbers of tenths of inches daily recorded is a matter of anxious interest.

Large output expected.

Lapse of timber to lessor.

Extraction of teak more difficult.

Everything is combining at present to make the extraction of teak more expensive and more difficult. The establishment of the Siamese Forest Department, an indispensable machine for the proper collection of revenue and the protection of the forests, necessarily leads to restrictions resulting in fines for infringement of regulations, and the uncertainty and trouble caused by the institution, or threatened institution, of law suits.

Restriction of new regulations.

Increased price of elephants.

The price of elephants, without whose valuable aid timber cannot be dragged, has gone up three-fold, though it is to be hoped that this is only temporary, and labour has not only

become more expensive, but, what is more, serious becoming exceedingly difficult to obtain.

Scarcity of labour.

The heavy labour in the teak forests is performed by Khamoos, a hardy hill tribe hailing from the district around the Nam-U to the north-east of Luang Prabang. They are a dirty, ignorant, but for Indo-Chinese people, hardworking race, and have always monopolised the working of the forests in Siam. Before the annexation of the east bank of the Mekong by the French in 1893, they came down in large numbers to Siam, and were willing to work for very small wages. They were conveyed by headmen of their own tribe, who arranged their engagement for a period of one or two years with forest contractors at a rate varying from 30 rs. (2*l.*) to 50 rs. (3*l.* 6*s.* 8*d.*) per annum, and food, which comprised rice, tobacco, and curry-stuff. The food costs about 5 rs. per month, or say, 4*l.* per annum. Many of the foresters to whom they were hired never settled up with them at the end of their term, but by promises and small presents induced them to remain, so that it was not uncommon to find Khamoos working for foresters who had failed to pay their wages for five or six years. After the French annexation all these Khamoos became French subjects, and the French Consul made their hiring a special branch of his Consular work, and brought pressure to bear on defaulting foresters to pay arrears. Many Khamoos, finding themselves suddenly wealthy in the possession of 100 to 200 rs., at once returned to their homes, and only the few who had taken to themselves wives and settled down in the country village remained behind. This exodus soon began to affect the supply of labour, and during the last two years this has been accentuated by the much smaller number of men coming down, and the majority of time-expired men returning to their home. It is just at this time, too, that a larger supply of elephants are working in the forests, and all possible efforts are being exerted to hasten on the delivery of timber which may lapse to the lessor, according to the clause in the leases already referred to. This lessened supply and increased demand has had the natural result of raising the scale of wages, and new men, who formerly would only have received 40 rs. (2*l.* 13*s.* 4*d.*) per annum and food, are now paid as much as 120 rs. (8*l.*) with food, which in the meantime has gone up 50 per cent. in price, while experienced men, capable of managing an elephant, demand 240 rs. (16*l.*). Thus it happens that labour which some years ago cost, say, 110 rs. (7*l.* 6*s.* 8*d.*) per man per annum, now costs 210 rs. (14*l.*).

Failing Khamoos, the only labour available is the native of the country, the Lao. Unfortunately they are very indolent and possibly physically incapable of performing heavy continuous labour, and not even the attraction of what is to him a small fortune will induce them to undergo for any length of time the hard labour and isolation of forest work. The British firms and

the Burmese foresters are now, however, compelled to supplement the supply of labour with this unsatisfactory material, but it is invariably found that after the original advance has been worked off, and the Lao is a few rupees in pocket, he goes back to his native village to smoke native cheroots and bask in the sun.

Labour question serious.

The question of labour is indeed most serious, and if the supply of Khamoos keeps on diminishing, timber men will be at their wits' end to find means to carry on their works. Schemes for importing labour have been discussed, but on account of the climate the expense and the risk have never gone beyond the point of being mooted.

The amount of British capital estimated to be invested in the teak industry is 2,000,000*l*., and the British companies are full of anxiety at the present moment. The fact of working expenses going up by leaps and bounds, the supply of labour threatening to be quite inadequate to the demand, the difficulty of inducing the native contractors to comply with the new forest regulations, and, above all, the uncertainty of the renewal of leases, and the still greater uncertainty as to what new regulations the Siamese Government may wish to insert in the new leases, all combine to render the position of the teak merchant in Siam anything but a bed of roses for the time being.

It was inevitable that after the lax and reckless way in which the teak forests had been worked for many years that all sorts of difficulties should arise from the enforcement of new regulations, and a great deal of labour has devolved upon the authorities of Great Britain and Siam in smoothing over these difficulties; but much still remains to be done, and some time will necessarily elapse before the new regulations will work without friction, and the conflicting interests of the Siamese Government and the British merchants equitably adjusted.

Forest Pests. *

1. In September 1899, the Deputy Conservator of Forests, Western Circles, forwarded some caterpillars which he reported to be defoliating teak trees in the Thana district. On examination they proved to be the lavæ of the moth Paliga damastesalis, Wlk. It has been reported almost every year as defoliating teak in various parts of India.

2. In September 1899, the Reporter on Economic Products to the Government of India, forwarded a series of the larva, pupa and imago, of a moth, the larvæ of which were said to be defoliating sál trees in Jalpaiguri. On examination the moth proved to be Lymantria grandis, Wlk. It has been frequently reported before as defoliati*g sál in India.

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* Indian Museum Notes, Volume V., No. 2. Price, Re. 1.

3. In January 1899, we received from Mr. J. C. McDonald, through the Superintendent, Madras Central Museum, some coccids which were reported to be attacking the roots of Erythrina six months old. Mr. McDonald writes :—

"These insects attack the roots of Erythrina plants six months old, and have in fact wiped out wholesale a field of fifty acres, which is shaded by the above tree. The damage began to be apparent about the burst of the North-East monsoon in November or so. The soil is quite a dry, light, and very friable one. This is the first that I have seen of this sort of damage after an experience of over 18 years of planting."

The specimens were forwarded to Mr. R. S. Newstead for identification, and his report has not yet been received.

4. In March 1900, some beetles were forwarded by Mr. G. M. Ryan, Deputy Conservator of Forests, Western Circle, from Thana district, Bombay, which he found burrowing into Khair (*Acacia catechu*) trees. This beetle (Sinoxylon sp.) has been frequently mentioned in Indian Museum Notes as attacking sál (*Shorea robusta*), *Terminalia belerica*, the guava (*Psidium guava*), and other trees in different parts of India.

5. In February 1899, Mr. G. M. Ryan, Deputy Conservator of Forests, Western Circle, forwarded some leaves of *Diospyros Melanoxylon* which were covered with galls. The leaves were forwarded to Mr. G. B. Buckton, who discovered a Psylla within the galls, which on examination proved to be new to science. He has described it as Psylla obsoleta. His description will be found on page 35, and the insect and gall are figured on plate V. (figs. 10—15.)

6. In July 1899, the Manager, Court of Wards Estates, Backergunge, forwarded through the Director, Department of Land Records and Agriculture, Bengal, some betel leaves covered with insects. These on inspection proved to be Aleusodids, and being new to our collection were forwarded to Mr. G. B. Buckton for examination. The insect proving to be unknown to science, Mr. Buckton has described it under the name of Aleusodes nubilans. His description will be found on page 36, and the insect itself is figured on plate V. (figures 7—9.)

The Manufacture of Turpentine and Colophony in the Punjab.

The following account appears in the Punjab Annual Forest Report for the year 1899-1900, which has been reviewed in the February Number (Vol. XXVII., No. 2) of this Magazine :—

"The operations for utilising *chil* pine resin may be noticed in some detail. During the season 1898-99, 16,500 blazes yielded 1,392 mds. of crude resin, including 450 mds. mentioned in para. 52 of last year's report. The total cost amounted to Rs.4,110-12-6, or an average of Rs.2-15-3 per md., including the cost of all tools, pots, &c., and carriage to the distillery at Nurpur.

An experimental distillation of 309½ mds. was made with country stills at a cost of Rs.381-5-0, including that of packing and landing at the Agency depôts in Amritsar and Lahore. The yield was 229 mds. 38 seers of colophony and 2,823 quart bottles of turpentine, or an average per md. of 29 seers, 11·5 chataks of colophony and $9\frac{1}{10}$ bottles of turpentine. The sales up to the end of June 1900 amounted to 343 mds. of crude resin, 87 mds. of colophony, and 1,415 bottles of turpentine, realizing Rs.3,979-2-4. The result of last season's working was, therefore, an expenditure of Rs.4,496-13-6 and a revenue of Rs.3,979-2-4, with a balance in stock of 740 mds. of crude resin, 143 mds. of colophony and 1,374 bottles of turpentine. During 1899-1900, 60,500 blazes are being worked, and the yield to the end of June 1900 amounted to 3,108 mds., and is expected to rise to 6,000 mds. by the end of the collecting season. The distillery plant has been supplied by Messrs. Garlick & Co. of Bombay at a cost of Rs.5,370, exclusive of carriage. The requisite buildings were constructed and the plant put in position by the end of the year, ready for work to commence at the beginning of the rains. Subsequent working will be detailed in next year's report; it may, however, be stated that the plant has proved to be capable of disposing of 31 mds. of crude resin a day, that the average result per 100 mds. is 170 gallons of turpentine and 70 mds. of colophony, and that the cost of distillation, including all charges, comes to Re.0-6-6 per md. It is hoped that the N.-W. Railway will take all the turpentine, and there seems to be no difficulty in disposing of the colophony, chiefly for making bangles. A clear profit of Rs.2-8-0 per md. is expected. The experiment gives promise of being most successful, as the product can be profitably placed on the market at lower rates than the imported articles."

Experimental Fruit and Vegetable Gardens in Burma.*

Experimental gardens.

Reports are received from the experimental gardens at Taunggyi, in the Southern Shan States, at Sinlumkaba in Bhamo, at Sadôn and Sima, in Myitkyina, and at Falam in the Chin Hills. The reports are printed in full in Appendix I. of the Report with exception of that on the gardens in Myitkyina. In these two gardens little but English vegetables have been grown, but experiments are now being made with apple, pear, peach, plum, and apricot trees. Strawberries have also done well.

The Deputy Commissioner points out that an orchard at Myitkyina would probably be in a few years self-supporting. Myitkyina is within 30 hours of Mandalay and 48 hours of Rangoon by rail, and it would be possible to supply both markets with English fruit.

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* Report on Land Records and Agriculture, Burma, for the year 1899-1900. Price, Re.1 = 1*s*. 6*d*.

Bhamo.—The orchard at Sinlumkaba has made a good start. Most of the young fruit trees are thriving. Lichees have failed and filbert and cobnut, gooseberry and currant trees do not promise very well.

The Deputy Commissioner wishes to devote more attention to those fruit trees that will not grow in the plains and whose fruit will bear the risk of transport to market. At Bhamo, Myitkyina, and Katha peach trees have yielded an abundance of fruit in private gardens, and there is no doubt that they grow in those districts equally well in the plains as on the hills.

Chin Hills.—The Government grant was only made for the orchard and garden at Falam, but half of the fruit trees obtained were planted at Haka and Tiddim. At these two posts there is no gardener, and most of the fruit trees have perished. At Falam three-quarters of the trees planted still survive. Strawberries and English vegetables, except broccoli, do very well. The Chin Hills are at present out of the reach of any large market, and it would be useless to grow more fruit and vegetables than are needed for the European population in the Hills. Even potatoes are said not to be relished by the Chins, and are grown solely for sale to Europeans.

Southern Shan States.—The report on the Experimental garden at Taunggyi is not published this year separately. Experiments in wheat cultivation are no longer carried on, as the Shans are fully alive to its importance, and are able to grow wheat without further encouragement in the Mayelat. The vegetable garden was washed away by two floods in October and November, and consequently the receipts from the sale of vegetables have diminished from Rs.216 last year to Rs.128-12-0 this year. The dry-weather crop of potatoes was fairly good, but the wet-weather crop was a failure. Potato-growing by Shans is not expected to progress until some facilities are afforded for reaching the Burma market. In the orchard, strawberries have done well, and there was a good crop of peaches, but unfortunately much of the fruit was ruined by cockchafers. The nectarine trees have yielded an abundance of fruit. The Superintendent has now proved satisfactorily that the *Docinia Indica* is suitable for grafting European apple trees on. The total expenditure on the garden and orchard was Rs.3,844 and the receipts obtained by the sale of the produce amount to Rs.1,778.

English Vegetable Seeds.—In Pakokku the experiments were carried out by the District Officers and by the Assistant Conservator of Forests and were fairly successful, especially with radish, lettuce, carrots and peas. In Mandalay, the rain in November washed all the plants out. In Bhamo, ants destroyed the carrots and turnips in Shwegu, while in Bhamo town a blight attacked the tomatoes. In Myitkyina, the vegetables were grown in the Sadôn garden; cabbage, broccoli, khol, rabi and beet did not get enough water, and turnips were eaten by insects. In the Sima garden

most of the vegetables did well, but were not so good as last year owing to heavy rain. Turnips, tomatoes, celery, parsley and French beans sown in April were good in spite of the warm weather; beans, lettuce, parsley, khol, rabi and tomatoes grown during the rainy season did fairly well. In Katha, the experiments conducted by the Burmans gave little or no results, turnips and peas were fairly successful, while asparagus did well in the jail garden. In Sagaing and Shwebo, where there should be little reason for failure, the experiments were not successful, due to the general difference shown regarding them, also to the heavy rainfall in Sagaing in November.

In the Upper Chindwin, the vegetables proved a success and were useful, and partially failed only in the Kindat and Mingin townships; in the latter case due to heavy rains. In Meiktila, the experiments were only a moderate success. They were grown by Chinamen. In Myingyan, the vegetables were planted by a Burman, and due care is said to have been given to them, but without success. In the Chin Hills, at Falam, no record of the early sowings were kept owing to officers being absent on column duty, but the seeds appear to have given good results. Vegetable seeds were also sent to the Superintendent of the Northern Shan States. The sowings made during the rains are reported to have failed owing to heavy rain and want of sunshine. In the dry weather, the vegetables, with the exception of three, asparagus, onions and parsnips, did well. The Shan cultivators were successful with English tomatoes, and it is said that if seed were imported in large quantities the indigenous variety would be neglected in their favour. The garden at Lashio is some distance from wells and all the water has to be carried up. Red, white, and black ants also gave much trouble and no means was found of getting rid of them. If the ground is constantly being dug up, however, it is probable that the ants will cease their attacks.

The Imperial Institute.

Quarterly Report by the Director of the Scientific Department on enquiries conducted for the Government of India.

I have little to add to the statement made in my Quarterly Report of July last, owing to the intervention of the summer vacation. Work has now been actively resumed, and several investigations on the subjects previously mentioned are nearing completion, and will be reported upon at an early date.

Since the date of my last Quarterly Report, commercial opinions as to the value of the gum of *Prunus eburnea* and of Malabar Kino have been obtained and forwarded to India.

(Sd.) WYNDHAM R. DUNSTAN,
Director, Scientific and Technical Department.

4th October 1900.

V.—SHIKAR, TRAVEL, &C.

A Bare Statement.

Are the coolies all ready? Yes! Well, that's all right. We've got to go to the top of that hill, have we? Anyhow, it does not look far. Great Scot! but its a goodish stiff climb. Now we're at the top. What ho! Still farther is it? These hills are jolly deceptive. At last we've got there. Where are we going to sit? So this is the place—thank goodness, I've got here alive after that terrible climb. Nasty, damp-looking place, too, under yew trees. Anyhow, its more comfortable than deodar needles. Wonder, which way the bear will come, if there are any. So this is the place where a Sahib had three shots last year and did not get anything. I hope missing isn't catching (something weird about that last remark, will some cricketer kindly explain what I mean). When *is* the beat *going to begin?* Let's have a look at the armoury. Give me the ·500 Repeater, and just be careful you don't let off that ·450 Martini by mistake. Can't get comfortable on a slope of 45°; one's knees get too far away, and then one's feet slip. Don't suppose I shall be able to hit anything at all. Suppose the bear came up that nullah to the left, or perhaps up that ridge to the right; but, above all, I hope they won't get up out of those bushes just below me. Thank goodness, they have commenced. What a long way off the tom-toms sound. There's only one man out of 40 shouting. What brutes they are! Why don't they give tongue properly? Hullo! what's *that? What an awful* shock to get over an old fox—but what a beauty! The old Shikari, I notice, is sitting closer to me. Don't believe the old man can see or hear much. Do I hear a trampling of leaves away to the low right? Yes, I do, by jove. Let's have another look at my pop-gun. Aha! there he comes up the ridge, a fine large black bear; can't see much of him. Hope I shan't miss. Why in the dickens doesn't he come out into the open—ho, yes; bad luck take him, he's turning off; must have a shot. Can only see his head and neck. Bang! hullo, he's dropped backwards. Must have hit him in the neck, as he didn't utter a sound. What! not *got him, you old fool?* Of course I have. I'll go and have a peep. Right Oh! he's as dead as mutton. I can see his *legs in the* air. Get ready again. Guess those coolies can make enough row when there is a prospect of a wounded bear breaking back. Why, here's another big bear coming up almost behind the other, but giving a better shot. Bang! I've hit her. What a row she's kicking up, yet on she comes. Another shot, that's downed her. Ho! by jove, she's up and off again. A couple more shots land her at last. What awful tough brutes they are. Here, hiyou old Shikari, give me some more cartridges. What! got no more? Never expected *to get five* shots; then hand me the ·450. Whirroo! there goes another, but what a little'un; can't see it. *Its bolt*-ing back diagonally across the line of coolies at full tear. Bang! that was a risky shot, the coolies dead behind it. Wonder,

if I hit it. Shikari says no; then I must have. Coolies are close up now. What! I have bagged the little one, have I; thought so; where is it? 180 yards down to the left in the open. What good luck. Let's go and look at the others. Here's No. 2, a fine female, but in what a mess. One bullet in the shoulder, two behind it, and one a little further back. They do take some hitting. Now for No. 1. What a rummy sight—a male, I hit him behind the ear and he was caught up against a yew tree on his back. No wonder he didn't get far. Bring them down to camp whilst I have a look at No. 3. There he is a goodish way down the hill in an open spot encircled by admiring coolies. What a hole in his side behind the shoulder. It's a wonder the little beggar got so far. What did you say? Never heard of a Sahib shooting three bears in 5 minutes; don't you believe it. No more excitement to-day; but what good luck, and shooting not altogether so bad, especially after having done a 10-mile march, padding the hoof the whole way. Never expected it. Now for a drink and a tub.

P.S.—The bears measured respectively 6′-10″, 6′ and 4′-6″, not so dusty.

E. RADCLIFFE.

VI.—EXTRACTS, NOTES AND QUERIES.

Observations on Packing and Transport of Plants, Fruits and Seeds. *

By J. H. Hart, F. L. S.,

Superintendent, Royal Botanic Gardens, Trinidad.

To insure the successful packing and transit of any commodity, it is first necessary to be certain that the material to be sent is in a fit state to be packed. Plants, fruits and seeds are no exception to the rule.

In the first place, a plant should be well rooted, well established, not overgrown, nor too small. It should be clean and free from injury and disease (parasitic insects or fungi), and should carry a certain number of foliage leaves.

A fruit should be full grown or mature, but not fully ripe, free from bruises of any kind. The stalk should not be pulled out, but clean cut. The exterior of the fruit should be perfectly dry.

Seeds should be freshly gathered, not kept in hand longer than actually necessary.

The following are a few of the various methods recommended for packing plants, fruit and seeds. :—

Plants.

The art of packing plants consists in maintaining their vitality uninjured while in the packed state, and in securing them from damage during transit.

* West Indian Bulletin. The Journal of the Imperial Agricultural Department for the West Indies. Vol. I., No. 3. London Agents: Messrs. Dulan & Co., 37, Soho Square, W. Price—Threepence.

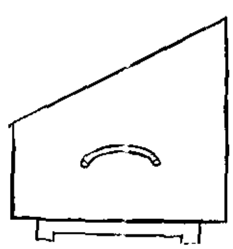
The best appliance in which to enclose plants which have to be sent long journeys is the *Wardian case*. This may be briefly described as a glass-roofed, wooden box of any required dimension.

Plants in the tropics are nearly always in a growing state, and excepting bulbous plants, they can seldom be packed in a resting condition. There are some plants, however, such as agaves, orchids, cacti, &c., which travel well, if packed in dry shavings, in a well-ventilated, ordinary, packing case. Roses and plants of like character, coming from a temperate climate, are best packed in the autumn in the resting condition, but they should have sufficient moisture in the packing about the roots to sustain growth when they reach the high temperature and humidity of the tropics.

The Wardian case is primarily intended to preserve the vitality of growing plants by affording them sufficient moisture, light, and air. This is effected by constructing the case in a certain manner, thus keeping up a regular supply of moisture for the use of the plants. Plants in Wardian cases are given only sufficient ventilation to prevent the interior temperature reaching an excessive height.

There is considerable variation in the form adopted by different packers in constructing their cases. I have prepared diagrams of three of the most common forms :—

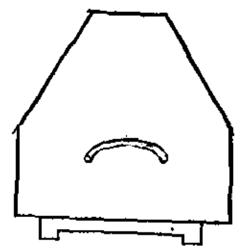
No. 1 has a roof sloping one way only ; No. 2 has a gable roof with a flat, boarded top ; while No. 3 has a sharp pointed gable roof. No. 1 is the cheapest, No. 3 the most expensive. No. 1 is the cheapest, because it is of very simple construction, but it has several disadvantages. It does not allow much head room, and from its form it offers a tempting seat to the lounging passenger, resulting in broken glass and damage to its contents. It is of the utmost importance that the glass of a Wardian case should be kept intact, otherwise the contents are liable to serious injury from drought, sea-water, rats, mice, &c. ; in fact, the main object of the case is destroyed when the glass is broken.



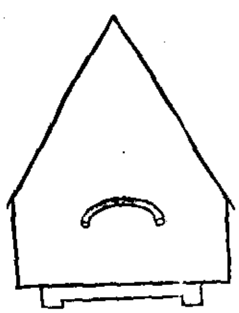
No. 1.

The form of case I have called No. 1 does not permit of easy handling without upsetting ; for, if lifted by the handles, one side is found to be heavier than the other, and the case turns a somersault. A well packed case, however, should be capable of being turned *completely upside down without injury*. The condensation, which takes place on a glass roof with one slope, will, of course, be delivered on one side of the case only, and thus the packing material around the roots on the higher side of the case will be gradually deprived of its moisture, and the plants on that side will suffer This case is not nearly so strong as Nos. 2 and 3.

The chief advantage of No. 2 is that it gives a larger amount of room for the same "ship's measurement" than No. 1, but it has the serious disadvantage of having a flat top. This flat top condenses moisture, and the water accumulates on the smooth surface of the wood in large drops, and these instead of running down on the inside of the glass, as in Nos. 1 and 3, fall into the centre of the case, and, if they happen to be delivered full on the stem of any plant, that plant is very likely to be killed before the end of its journey. No. 2, when carried on deck, also admits of use as a seat.



No. 2.



No. 3.

The third form of case is that generally used by the authorities of the Royal Gardens, Kew, and it is in the writer's opinion better suited to the transport of plants for long distances than either of the others. The condensed moisture of the interior is equally distributed by the sloping glass roof.

The only fault attached to this case is that by "ship's measurement," taken to the pointed apex of the roof, it has more cubic contents than Nos. 1 and 2, but this is probably more than compensated for by its not affording a deck seat. This case has an advantage over No. 1 in that its centre of gravity is much lower, reducing the risk of turning over when handled.

Wardian cases should always be packed under cover, the plants should be ready some time before, and should be in that condition known to cultivators as "damp" (*i.e.*, neither in want of water, nor too wet.)

Cleats should be arranged in the interior of the longest side of the case, having notches one inch deep and some three or four inches apart, into which cross bars should fit when the plants are all in place. The packing material should be light in weight and somewhat absorbent, such as leaf-mould, peat, or cocoanut refuse. As the plants are placed in the case, this material should be packed neatly around the pots and rammed firm with a rod small enough to enter all the interstices. When finished, the surface of the packing should be level and the rims of the pots just covered with the packing material. Clay pots, the new metallic pot, or pots of bamboo may be used. When plants are turned out of pots, each plant should be tied up in sacking into a solid ball before packing. No plant should ever be placed loosely into

the packing of the case. It is better to place the plants regularly in rows lengthways, and when the packing is finished, or while it is proceeding, some coarse straw or dry twigs should be placed between the rows, and these will keep the packing firm when the bars are in place. The bars, one inch square, should cross the box from side to side, fitting into the notches of the cleats. A similar cleat with notches will now take the ends of the cross bars nearest the packer, and being well pressed down, should be screwed or nailed securely. The cleating should be sufficiently strong to prevent the packing from moving, even if the case is turned upside down with considerable concussion. The packing being finished, it is well to sprinkle the interior of the case with a little water, but great care must be exercised in this matter, as too much or too little may mean the destruction of the plants. The best plan is to pack the case two or three days before it is required for despatch, and to close it up when seen to be in exactly the right condition. This condition, however, is one which only the experienced eye can secure, and cannot be described.

All Wardian cases should be glazed with rough plate glass, but if clear glass is used it should have a coating inside of white paint, to keep out direct light. The glass roof should be protected by cleats of wood of sufficient strength, placed at intervals which will not allow corners of other packages to break the glass. It has been stated that a great deal of the safety of the plants in a Wardian case consist in having the glass unbroken. If this unfortunately happens, the breakage may be temporarily repaired by pasting a parcel label, or piece of light cloth, over the fracture; this will often save a valuable lot of plants from irreparable injury. It is a good plan when shipping plants to put a notice to this effect on the case. I have always found ships' officers willing to attend to such a trifling matter if it is brought to their notice. On one occasion I observed a captain regularly superintending the washing of decks near a large case of valuable plants, in fact, he looked after it better than the owner.

Plants sent from the tropics to the temperate zone should only be despatched when there is no danger of cold weather on the voyage. For many years the Trinidad Department has arranged to send plants to Europe and America only during the summer months, as it had been found that ninety per cent. of the failures were due to having to pass through a low temperature. Hence all our arrangements are made for June, July, August and the early part of September.

Plants coming to the tropics from hot houses in temperate climates can only be sent with certain safety during these months. Occasionally they may come through with safety at other times, but there is always the chance of their getting a cold snap in the

Channel, or on a railway platform, or wharf, which may seriously injure or destroy them.

Orchids in their growing stages should always be sent in Wardian cases, but if resting or dried they may safely be sent in ordinary closed cases, packed loosely in dry wood shavings, and well-ventilated by small openings, covered with perforated zinc to keep out rats, mice, &c. The chief point in packing plants of this class is to support them with the packing, at the same time allowing sufficient ventilation to prevent fermentation, or mould fungi accumulating on the tubers or leaves. If packed in large cases, plenty of struts or bars should be nailed in the cases stretching from one side to the other to take off the weight of the plants, and not allow them to press too heavily one upon another. Orchids are best sent immediately after flowering.

Filmy ferns (species of *Trichomanes* and *Hymenophyllum)*, are best sent in tight cases (even tin-lined cases may be used), packing the plants between layers of soft damp moss, so as to form with the ferns a soft, wet, spongy mass all through. Many lowland ferns from wet districts, such as *Danæa* and *Marattia*, will also go well by this method, but ferns, as a rule, must be in Wardian cases.

A case of filmy ferns sent to Kew, as above described, during the past year, reached that establishment in excellent condition.

In packing plants from the open ground, for local transport, care should always be taken to water copiously before taking them up, so that they may contain a large amount of moisture, and their vitality be better preserved during transit.

Care should always be taken to prevent the exposure of the roots of any plant to dry air or sun, as a few minutes will often do an immense amount of harm.

Fruit.

My first experience of packing fruit for ocean transit was in October, 1873. In that year I sent a box of Nova Scotia apples from that country to England. I ventured to mention at the time to Dr. Masters, "I think Nova Scotia bids fair to become the apple-producing country of the future." How far this has been realised is within the knowledge of many who have seen these apples in the English market. My consignment was a successful one; Dr. Masters reported: "They were packed in coarse sawdust, and came to hand almost without a bruise." These apples were among the first, if not the first, sent to England from Nova Scotia. To-day the trade is of considerable dimensions. I mention this to show that by good packing much may be done in the way of exciting interest in new productions in suitable markets.

Some people hold that only valuable goods are worthy of good packing, and that cheap things will not pay to pack well. Such arguments are fallacious. So far as my own experience goes, whatever is worth packing at all is worth packing well, for even if the packing costs more than the article itself, it should

nevertheless be put upon the market in the best possible condition. Cheap and ineffective packing is dear at any price. It is clear that it is better to expend 20 per cent. on packing, rather than lose 40 per cent. or 50 per cent. of the returns owing to defective packing. West Indian orange growers have been heard to say: "We cannot afford to pack the same as the Mediterranean people." The reply is clear. "Then do not expect to get a market for your goods." There can be little doubt that in the fruit trade the profit comes chiefly in the economy with which the packing is carried out. By economy, I do not mean cheapness. There is economy in effectiveness, as well as in cheapness. It is certainly false economy to pack *fully ripe oranges* in barrels for cheapness.

With fruit, as with plants, the material must be in good order. It will never pay to shake down the oranges from the tree to the ground, carry them for miles in a cart, and then shunt them into a barrel. Success can never attend such handling, for all fruit must be handled as carefully as eggs. A blow that would crack an egg will certainly destroy a fruit; and if such fruit is packed, no matter how carefully, it will assuredly arrive at its destination in bad order. To secure arrival in good condition all fruit must have been carefully gathered, and, without exception, treated in the most careful manner to prevent bruising.

Fruit also requires certain treatment previous to packing to assist in securing safe transit. This treatment is what I would call "hardening." No fruit should ever be packed when freshly gathered, but how long it should remain must be learnt by experience, as a great deal depends upon the state of the weather. Oranges should be picked at least three or four days before packing, and laid out in single layers until all the moisture, or what is known as the "sweat" of the fruit, has disappeared. To pack fruit when wet or damp, is to court certain failure. The full details of packing are too long to include in a paper of this kind.

There is one point in connection with temperature which must be taken into account. If fruit, such as bananas, are kept at too low a temperature they become "chilled" and will rot before they will ripen. It has been frequently stated that to carry fruit successfully, it is necessary to use ice chambers. I believe this idea to be a mischievous one, and it has hindered in no little degree the problem of the safe transit of fruit. The Jamaica No. 11 mango was safely sent to England from Jamaica in 1873, when the transit took 21 days from port to port. In 1875, and again in 1891, the mangosteen reached home from Trinidad in good condition. In no case was cold storage used. Apples, which reach the West Indies in ice vessels, if packed near the ice, are valueless for flavour, while those brought over in well-ventilated packages, stowed properly in a cool part of the ship, arrive in excellent condition, and keep their flavour for a great length of time.

The exact degree of temperature suitable for the cold storage of fruit is not sufficiently well understood. Some people take it to be at or near freezing point, while others adopt temperatures of say 40° or 50° Fah. This latter, I believe, would be a good temperature for fruits grown in a temperate climate, but if we are dealing with tropical fruits, it is probably too low. Cold storage at freezing point may do for dead meat, &c., but is not suitable for the preservation of fruit. Still, we must have *cool* storage, and how to obtain the desired temperature, must be decided by shipowners and by shippers of fruit.

What is required is a well-ventilated hold, maintained at a certain minimum temperature which should be some 10° or 15° below that at which the fruit matures. Fruit will stand considerable hardship, provided it is carefully gathered, well dried, and well packed. It is not easy to say, however, which of these three conditions is essential. If a fruit is bruised in the picking, it is inevitably doomed to rot. If not carefully dried, it will almost as surely ferment and rot, and if squeezed or heated in the packing, it must arrive in a bad condition.

The best cases for packing oranges are those furnished with trays admitting one layer only, with bars to take the weight when set on end. A very good and serviceable case is one having a capacity of two cubic feet and divided in the centre. In a barrel the lowest row has to sustain the weight of all those above it, which may amount to something like three to four pounds per orange. *The continued use of the barrel for oranges and similar fruit helps to bring our beautiful West Indian fruit into grave discredit.*

The package of pine-apples has to be conducted on the same principle. They should never be packed in barrels but in light crates, each fruit having a separate compartment. Small and indifferent fruits are rarely worth shipping, and, if in abundance, should be preserved or sold locally.

Mangoes can be safely sent, if picked in the condition known as "full," so as to gradually ripen during transit. In this case it is also necessary to separate the individual fruits, and high class fruit should be packed in the manner adopted for apricots and peaches by European growers, namely, in single compartments with soft packing material.

The actual business of packing fruit is an art which only practice can perfect, and most of the failures are due to imperfect knowledge of the conditions which are necessary to success.

A common idea exists that cultivators can, by planting at certain times of the year, get fruit, such as mangoes and pine-apples, to ripen at certain seasons. This may sometimes be possible, but I am of opinion, after a quarter of a century's experience, that the control which can be exercised by the grower over the time of ripening is small, and cannot be depended upon for successive seasons. If we could control wet and dry weather, in the

same way as under glass cultivation, something might be done; but until we are in a position to do this, the mango and pine-apple season will be in June, July and August, the coffee crop will come in November and December, and cacao will ripen in June and November, with variations of dates in accordance with the season.

There is great need for study of the possible means to get a crop of fruit out of season, for fruit out of season is well known to pay. I think, however, that more success will come if the attack is carried on from a different direction. It is true that we might by withholding water imitate the dry season, and by giving water imitate the wet season; but still uncontrollable differences would yet remain, for it is clear that we could not control the state of the atmosphere surrounding the branches even if we kept the roots dry, and we could not give the dry air coincident with the dry season, during rainy weather, and if we kept a plant well watered, its branches would still be affected by the drought.

The best means to obtain the end in view, would be to seek plants which ripen earlier or later than the general crop, and by selection obtain varieties which come in extremely early, or conveniently late, and thus meet the demands of the "out of season" markets. Selection of this kind is carried out in Europe and America, and might equally well answer in the tropics if a little attention was devoted to the subject.

I have digressed somewhat from packing and transport of fruit, but I must plead the excuse that we must know how to get our fruit before we can pack or transport it.

Seeds.

Some people are under the impression that the Botanic stations maintain seed shops, where any kind of tropical seed can be purchased in the same way as from seedsmen in temperate climates. It is not so. There are very few tropical seeds indeed, which can be safely kept for more than a month, a great many which cannot be kept more than a week, and not a few whose vitality is destroyed in one or two days if not properly cared for. Thus, a seed shop under European conditions for tropical seeds is impossible.

Tropical seeds possess for the most part a very fugitive vitality, and are easily destroyed by an excess of either drought or moisture; but more quickly by the former. Even if left exposed to air, the humidity of which is generally high, they suffer largely, but if in a position where the alternations of dryness and humidity can effect them, they are destroyed in a very short time.

Proper methods have, therefore, to be devised to keep them in a suitable state until they reach their destination.

Such seeds as mango, cashew, nicker beans, some palms, &c., can stand a large amount of hardship and will keep for a long time, and may be packed in bags or boxes for transit. It is quite a different matter, however, with seeds of *Artocarpus*,

Brosimum, *Amherstia*, *Castilloa*, *Hevea*, *Cynometra*, &c., &c. Such seeds must be preserved in a suitable medium to keep them in good condition and preserve them for any length of time either in hand or on a journey. The best medium found so far is the fine dust or short fibre from the interior of the cocoanut, commonly called cocoanut refuse. This material is the lightest that can be employed and answers well for almost any kind of seeds. It is especially suitable for packing in tins for transmission by post.

Another material which has been successfully used is weathered charcoal dust. New or unweathered charcoal dust is just as bad for packing seeds as weathered dust is suitable, on account of its caustic character and the amount of moisture it will absorb from seeds packed in it. A danger with both materials is that spores of certain fungi get into them and destroy the seeds they cover.

Packing for delicate seeds should not be too dry or too wet, *but a happy medium between the two, just sufficient to* prevent the seed losing moisture and insufficient to start it rapidly into growth. On the whole, it is better that seeds should germinate on the way than be kept too dry, provided the process of growth does not reach beyond a certain stage.

Experience teaches that greater success is met with if seeds are started on their journey as soon after harvesting as possible, and not kept a day longer than is necessary. If only required for home use, they are best sown as soon as possible after being gathered.

There is another danger to which even the hardiest of our seeds are subject, and that is, the attacks made upon them by ants, weevils, and other small insects. Seeds which have suffered in this way are often to all appearance perfectly sound, but a close examination will generally show that the germ or growing part has been entirely destroyed. The seed is therefore useless.

Persons living in temperate climates, with no experience of the tropics, can hardly believe that seeds cannot be dealt with in the tropics as in temperate climates, *viz.*, gathered, cleaned and placed in a "dry drawer" until required. Proof that imported seeds will not keep is to be found in the universal complaint of the bad quality of the seeds which are on sale. Many trials of freshly imported seeds have been made at Trinidad. As a rule, they have been found to be good on arrival, and to lose vitality exactly in proportion to the time allowed to elapse since they were imported.

Peas, which on first arrival showed a germination of 98 per cent., kept for one month in a dry drawer will have their vitality reduced to 40 per cent., and in three months' time not 10 per cent. will germinate. Other kinds of seeds are affected in a similar way. If the period of test, however, happens to be in the dry season, vitality will be found to be more persistent.

These facts were recognised many years ago, and have been met by ordering periodical supplies at frequent intervals. Seeds can be kept for a greater length of time if they are imported in

packages which have been sealed in dry air in the temperate zone and only unsealed as required. The best packages for seeds are small tins opening readily with a thumb piece, like Huntley and Palmer's biscuit tins, or the tins used for packing Capstan tobacco. Continental seedsmen adopt new methods quicker than English traders. The latter do not appear to exert themselves to keep the West Indian trade.

The transport of seeds should always be made by the quickest route and by parcel post, where possible. Consequently they should be put up in light and handy packings.

SUMMARY.—(*a*) *Plants.*

1. Always select healthy and well-established plants.
2. Use dry, well-ventilated cases for orchids, cacti, bulbs, &c.
3. Pack filmy ferns, mosses, &c., in damp moss in closed cases.
4. Pack plants in growth, or likely to come into growth, in Wardian cases, well battened down, and see that the case contains the proper amount of moisture before finally closing.
5. Adopt the safest case, and ventilate sufficiently.
6. Take precautions to minimise risk of injury during transit; in particular guard against excessive illumination, drought, displacement and movement of packing material, breakage of the glass, changes of temperature, and damage from salt water, animals, &c.
7. When packing plants for short distances, it is sufficient to protect the roots and prevent rapid evaporation.

(*b*) *Fruit.*

8. Pick the fruit when mature, but not over-ripe.
9. Let the fruit stand some time before packing, so as to ensure a hardened surface and freedom from moisture. Handle it as carefully as eggs.
10. Pack so as to prevent movement and bruising, but do not squeeze.
11. Pack in small cases, *not in barrels*, and use cheap and light packing material.
12. Do not allow fruit to travel in too high or too low a temperature.
13. To obtain supplies of fruit out of season, select early and late varieties.

(*c*) *Seeds.*

14. Transport all tropical seeds as soon as harvested.
15. Keep seeds secure from attacks of ants and weevils.
16. Pack short-lived seeds in damp cocoanut fibre, or *weathered* charcoal refuse.
17. Ship always by the shortest route.
18. In the tropics import packages of European seeds in airtight cases, and open as required.

[*Note added.*]

Extract from "Gardeners' Chronicle," No. 674—Vol. XXVI., November 25th, 1899.

INFLUENCE OF DRYING UPON THE GERMINATION OF PALM SEEDS.

Seeds of *Oreodoxa regia* sent dry, packed in capsules of paper, did not germinate till after the lapse of one year and-a-half; whilst seeds sent in moist wood charcoal germinated in a few weeks after sowing. Comparing results, it was evident that out of about forty species of palms, only three or four species germinated when the seeds were sent over here dry, and of these only a few seeds; whilst almost all the seeds of nearly all the species germinated when the seeds had been packed in a moist medium, and arrived in a moist state.—*Dr. Udo Dammer, Gross Lichterfelde, near Berlin.*

Aborigines of the Nilgiris in South India.

The Nilgiris are a group of mountains, 6,000 to 8,000 feet high, connected with the Western Ghauts just south of Mysore, and are inhabited by five interesting native tribes, of whom four are aboriginal. The fifth tribe is that of Badagas, so called from Vada, which means north. Three hundred years ago these people came from the north, *viz.*, the Canarese country, after the breaking up of the great kingdom of Vijianagar, and they have maintained the Canarese language and the worship of Siva, which they brought from their northern home. They now number 20,000 and are very conspicuous near the large towns of Coonoor and Ootacamund, where they are the bulk of the day-labourers. They have a yellowish clayey complexion like the soil in which they toil.

The lowest of the four aboriginal tribes are the Irulas who live on the lowest slopes of the hills. They are of the Mongolian type of countenance and sell the produce of the forests to buy grain. They have no marriage ceremony, but each boy chooses a bride for himself when he is old enough.

They worship Vishnu under the name of Rangasawmy at a prominent peak known as Rangasawmy's Pillar. Their language is like the Tamil of the south country.

A more conspicuous tribe are the Kurumbas, who live on the higher slopes in hamlets of four or five huts each. The huts are constructed of wattle and mud. They live on roots and game and sell jungle produce. They also make baskets and milk vessels out of bamboo stems and play rude instruments at the funerals of the Todas.

Like the Irulas, they have no marriage ceremony, but allow the youths to make their own choice, and their widows can remarry.

They are very light, the men averaging only one hundred pounds in weight. "Stupid as a Kurumba" is a native proverb, but it is said they always tell the truth. Their number on the Nilgiris is hardly a thousand, but there are branches of this tribe on the Palani and other ranges further south.

Our engraving shows a group of Kurumba women and children belonging to a branch called "Muduvas." The meaning of the name is "back carriers," and they explain it by saying that once one of their women put her child down while she was at work in the jungle and a tiger carried it off. So ever since they have carried their children on their backs, even while at work. The picture shows the small children slung on their mothers' backs. It also shows the profuseness with which the women adorn themselves with rings, bracelets and necklaces. The advance towards civilization is shown by the caps on the boys' heads.

Somewhat more numerous than the Kurumbas of the Nilgiris and much more in evidence are the Kotas, the industrial tribe of the mountains. They live in seven villages, each containing from 30 to 60 huts. The only door of a hut is 46 inches high by 26 inches wide. They keep cattle, but do not milk them. They practice the industrial arts and till the land; their lands being the most fertile spots on the mountains. The women make clay pots on a wheel.

A Kota may have but one wife, unless that one is barren; widows may re-marry.

While the average weight of the men is only 105 lbs., they are twice as strong as the Badagas; yet they are despised because they live on carrion and may not approach a Badaga temple.

Each Kota village has two temples and two priests who are hereditary. They recognise one god and his wife.

Their possession of the best lands indicates their having come early enough to get first choice, and that, therefore, they must have preceded the Badagas, who are the only other cultivating tribe. It is said that they were originally brought from the plains to work for the Todas.

The Todas, the fifth tribe referred to, are the most singular of all the people on the mountains, and as such, have become objects of great curiosity to all visitors to the Nilgiris. One man of them was even taken to the Chicago Exposition. They were formerly hunters and are now buffalo-herders.

They have a copper hue and features of the Caucasian type. The women have a more aquiline nose than the men. The average weight of the men is 111 lbs.

They have long hair curled at the ends, and the women are careful to keep it in curls, thus differing from most women of India, who think curly hair a misfortune.

They are a lazy set. The men refuse to do anything but herd buffaloes and collect tribute from the Badagas and Kotas, and at the present time they beg from Europeans, who are pauperizing

them with constant gifts. The women work a sort of embroidery on clothes with Nilgiri nettles for stitching and English needles. Formerly the Kotas made needles for them.

They live in hamlets of five huts each called "Munds." Three of these huts are dwellings, one a dairy-temple, and one a calf stable for buffalo-calves.

They have a hundred mounds scattered over the mountains. Each dwelling hut has no other opening than the little front door, 32 inches high, by 18 inches wide, and one has to crawl in on all fours. These oval pent-shaped huts are of bamboo, fastened with rattan and covered with thatch.

They practise polyandry and, to a limited extent, polygamy.

A woman, when married to a man, is the wife of his brother as well, though the marriage ceremony is performed only with the eldest brother. Infanticide was formerly practised with reference to female infants, but the British Government put a stop to it.

When a woman salutes a man, she raises his feet, one after the other, to her forehead. An old woman, however, may receive this honour from a man.

Todas have games that they play something like "puss in the corner" and "tip-cat."

The dairy-temple is the abode of the priest, who only can enter it, and woman may not come near it. The priest keeps and milks the sacred buffalo-herd.

The Todas fear their priest, thinking that God dwells in him, and makes known His will through him.

The initiation to the priesthood is very severe. For eight days and nights a candidate must stay alone in the jungle, with no covering on his body and no other protection than that afforded by the juice of a certain tree rubbed on his body. He may retain office as long as he likes, and the usual term is three or four years.

Once a year a buffalo-calf is sacrificed. Their worship is mostly buffalo-worship. Their songs are in praise of their buffaloes. The only occasion when they are known to have risen higher than their buffaloes in song is the time when they composed a song in praise of a missionary lady, working among them, on her departure for England on furlough.

When a Toda dies, several buffaloes are slain to accompany him to the other world, and his arm is placed around the horns of one of the slain buffaloes.

They have green funerals and dry ones. The green funeral consists of the burning of the body with its attendant sacrifice of buffaloes and other ceremonies. The ashes are left to the winds.

The dry funeral is one that takes place at the beginning of each year in memory of all who have died the previous year. They gather together in great numbers and slaughter a number

of buffaloes and perform many ceremonies. The flesh of the slain buffaloes is given to the Kotas who furnish the music. The names of the dead are never mentioned again.

They think that a string bridge leads to heaven, and that hell is a swamp full of leeches. They have no idols. Except as they may have borrowed one or two from the Hindus. Their worship is that of the elements and ancestors, and has a pastoral coloring that indicates a Vedic origin. They have no written language, but their lady missionary has introduced the Tamil character to provide books for them.

They number 750. No one has ever been baptized as a Christian. One became a candidate and had prepared himself to arrange his matrimonial affairs in accordance with Christian requirements, but when it came to the loss of his share in the buffaloes of his family, he could not endure that and went back to his heathen life.

The Todas receive tributes of grain from the Kotas and Badagas. If a Badaga refuses tribute, all they do is to prepare to occupy a "mund" near the Badaga's fields. The Badaga would pay much rather than have a herd of buffaloes overrunning his crops. So the tribute is soon forthcoming.

The buffaloes are in a semi-wild state, and have been known to chase cyclists on the roads.

They do not seem to be decreasing, but rather are on the increase. But their constant cry for "Elam" (alms) indicates a degeneration of character resulting from the curiosity they excite among all foreigners.—*The Scientific American.*

Conservation of Feathered Game and Songsters.

We have frequently insisted that the ground and feathered game of India could be effectually protected did the authorities make it known that they were in favour of legitimate proceedings to ensure it, so hail with satisfaction the recently expressed intention of Sir John Woodburn to encourage acclimatisation and conservation in and around Darjeeling. True, His Honor's intention, so far as they have been made public, are confined to songsters and brilliant-hued birds, but the precautions taken with regard to them may well be extended to game, as both play important parts in forest economy. Great, no doubt, as is the havoc wrought among pheasant, chikor and partridge in and around our hill station by gun, trap and net, it is a mere fleabite compared to the destruction of eggs and young broods by the senseless annual grass fires, and that these are intentionally caused all experienced people know. Though writing in the interest of sportsmen and game preservation, the Forest Department, we feel assured, will endorse our opinion that stringent measures should be adopted to put a stop to the practice, in the interests, both of the Government revenue

and those of future generations of the people themselves; as so long as the reckless custom is unchecked, rehabilitation of jhumed tracts is impossible, and no one need be told that the evil of denuding our mountain's sides of their timber is becoming more and more apparent as time goes on. An abandoned jhum, at the end of the first rains, despite the rivened black stumps presents still, marked indications of promising rehabilitation were the sprouting second growth permitted to develope; luxuriant as is the crop of grass, the vigorous young timber shoots would hold their own and gain the ascendency were they allowed to do so; but as the dry March winds set in, whole mountain ranges are given to the flames, annihilating everything in their course, sweeping through budding plantations, while the dense rolling smoke penetrating to the innermost recesses of primeval forests in the neighbourhood scatters the ground game farther and farther afield, besides suffocating nestlings among the upper branches wholesale. Unless, therefore, measures to meet the evil are energetically taken, we may look in vain for domesticating the familiar birds of our temperate zones, while the indigenous ones must inevitably grow less and less. Fire paths avail little, for their extent to be of any service must be too large to admit of efficient patrol. Vigilant as was the watch kept on the forest reserve at Upper Shillong in the spring of 1877, and again ten years later, it did not prevent a conflagration that nearly involved the whole station in destruction. That these fires were intentional was proved by the finding of bamboo choongas stuffed with charred cotton placed in heaps of fir droppings to windward, but the Rs.200 reward offered failed to detect the incendiaries. Now, except in very rare instances, most of our hill slopes, as also the plateaux, possess numerous springs such as the one that issues from the side of Dodabetta, as you enter Ootacamund from the east, supplying the station with water by the well-arranged system of conduits led round the amphitheatre above the lake; the same conditions obtain at Shillong where a copious supply gushes out just below the peak grove; and as nearly all our hills enjoy the same conditions, there could not be much difficulty in arranging a system of easily blocked conduits, the overflow from which during the dry months would damp all vegetation over an enormous area; many small streams meandering through the prairie like plateaux could be dammed or diverted with the same object, and these waterways would admit of far greater and constant supervision than the open glades under the name of fire-paths that may be seen running for miles round our forest reserves. If it is not possible to eradicate from the hill stockman's mind that firing is unnecessary, let them work their will over strictly limit-areas, being held responsible for the fire spreading beyond such. Jhumers in many parts pay no rent or other compensation for the annual destruction they cause, but in common justice it may be demanded from them that they be called upon to construct the dams, conduits or diversions recommended.

We are influenced in what we write on conserving our moorlands as *The Field* in a recent issue mentions the gradual deterioration of the heather at Home, and, though no doubt, proprietors will take steps to preserve that indispensable cover for grouse, what we advocate would render feasible the introduction of that much-desired game to this country; and it must also be remembered that the timid hare—not the rabbit—when afforded a safe asylum, would prove a great acquisition. Previous to the establishment of the Shillong station, when the environs were tolerably well-wooded, the bamboo partridge abounded, but denudation and fires have well nigh obliterated him, that he in common with pheasant, would return is certain. Those who will go through Goodwin Austin's Book on "The Birds of the Naga Hills and adjacent Regions," will be astonished at the number of these attractive little beings; and if energetic steps are taken to conserve them, there is no doubt, but that the plantations and gardens, as also the small woods throughout our hills, would soon resound to their twittering and the landscape rendered gay with the flashing of their plumage. The Forest Department would incur no extra expense if the above suggestions were acted upon; the money now expended in clearing fire-paths and endeavouring vainly to beat back flames would simply be diverted into another, and we venture to assert, a much more effective means of combatting an evil that each year is intensifying in such disastrous effects as uncontrolable floods, destruction of all but the coarsest fodder over immense areas that should not only teem with game but afford grazing ground for raising that equine stock, but which the whole world acknowledges the present deficiency of. Close times and adherence to game laws could be much more rigidly exacted among the sparse population of our hill tracts than among the teeming bustees of the plains, though much might be effected in the low country could we enlist the sympathy of zamindars in the cause of game preservation; but we fear, in Lower Bengal more especially, so long as the large eka wastes remain in their present unutilised state, the prevention of jungle fires is well nigh impossible.—*Asian.*

Foresters at Cooper's Hill.

We have once more to bid farewell to our Third Year Foresters, who, early next year, take their departure for Germany for their practical course of forestry. We have always found, that, thanks to the physical test they have to pass before entering the College, the forest students are extremely useful to the College in many ways, and our departing friends prove no exception to the general rule.

Curiously, amongst the six men we lose three football captains:—Richmond, as captain of the Rugby fifteen, has done all that could possibly be expected of him, although he has been seriously handicapped by an injury to his knee received in the Oxford match. Robinson has led the "A" team to victory in every match it has played, and Burke has captained the soccer team through its chequered career this year.

In addition, Newman has greatly distinguished himself at "three-quarters" since circumstances compelled him to play in that position instead of forward, to which he was accustomed, and he has besides acted as Secretary both of the Dance Committee and of the Musical Society.

Hopwood has the distinction of being one of the best rifle shots and sprinters in College, and heads the list of those qualifying for a Government Forestry Appointment.

The extra forestry student Machhar is deservedly popular with his colleagues and all other members of the College, and some of his feats in the Gymnasium will long be remembered.

We wish them all the best of good times in Germany, and success in their subsequent careers in India.—*The Cooper's Hill Magazine.*

FLOATING ON THE MAUTAR GAD.

THE

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Floating Works in the Jaunsar Division, N.-W. P.

BY P. H. CLUTTERBUCK, I.F.S., F.Z.S.

In the *Indian Forester* for July 1900, there appeared a detailed account of the Kulni Export Works by which the sleepers are brought down to the Jarár depôt in the Mautárgádh. It may prove interesting to readers if a short account is now given of the way in which the sleepers are exported from there to the plains of India.

It may be stated at once that the export is done by floating, but this is effected by three distinct methods, which have to be adopted in accordance with the bed of the river and volume of water flowing in it. It will simplify matters if these methods are described separately.

I.—Telescopic Floating.

From the Jarár depôt, which is at the place where the wet slide ends in the Mautárgádh, to the place where that gádh or mountain stream empties itself into the Tons is about 5½ miles. The bed of the stream is rocky and full of boulders. At flood-time floating is found to be impossible, as the sleepers would get out of control and would be swept away and lost in the Jumna. Consequently special arrangements must be made, and the simplest and most economic method that could be devised is that known locally as telescopic floating.

Sleepers are taken and laid in the bed of the stream in such a manner as to form a trough-like channel into which the best part of the water of the stream is guided. The upper ends of the sleepers forming the channel are laid under or outside the ends of those next above it, and where too much water escapes the cracks are stopped with grass and leaves. The method can be understood from a glance at the accompanying photograph. The channel rests, as far as possible, on the boulders and rocks in the stream bed, but is propped up with sleepers laid crossways.

Where the bed is very uneven, sleepers are piled up to the required height. Where small pools occur, in which the sleepers can float easily without artificial assistance, the channel ends and commences again below the pool. When all the sleepers have been passed along, those forming the channel at the upper end are taken up, passed down, caught at the lower end, and laid, so as to continue the channel; and so on, until the Tons is reached. About 150,000 to 200,000 pieces, mostly metre-guage sleepers, are brought out each season, and the cost is about 7·5 pies per piece for the 5½ miles length. The number of men employed is about 100 at the commencement of the work, about 400 when the work is in full swing, decreasing to 80 or so at the finish. Of the men engaged, about 60 are Pachmis from the Punjab, and these are the ones who construct the channel. The remainder are local coolies. It takes about 75 days to transport the whole number over the 5½ miles to the Tons.

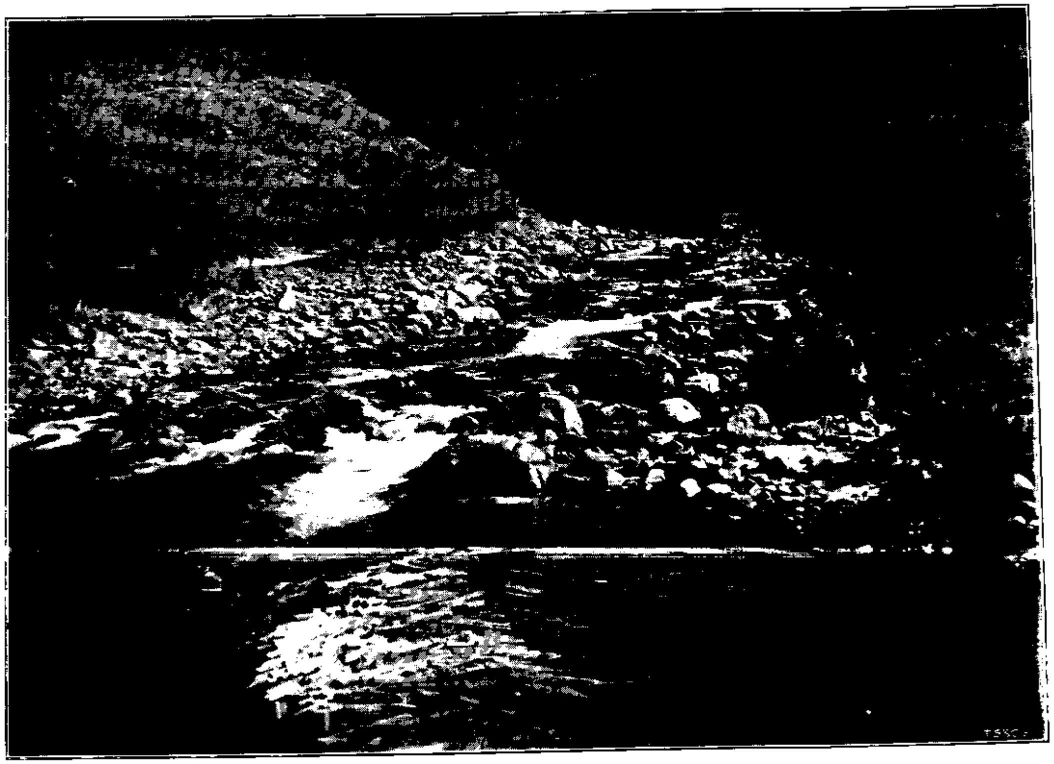
II.—Floating by Single Sleepers.

As each sleeper reaches the Tons, it is pushed out into that river and allowed to drift. The sleepers thus launched proceed on their way down until they get stranded, stuck in groups, or get out of the current into side pools. A gang of about 55 men, consisting of 1 head *mullah*, 6 *mullahs* on large *sarnai* made of inflated *sambhar* skins, 25 *mullahs* with small *sarnai* made of inflated goat or sheep skins, and the remainder *dúbáru*, *i.e.*, men who cannot swim, proceed along the river as soon as all the sleepers have been launched. They re-launch all the sleepers as they come to them, leaving none behind them. The large *sarnai* are used in the deep pools. The man who propels one of these lies across it on his stomach, using a paddle on one side and his feet on the other. He is well out of the water, and keeps himself quite dry except his feet. These large *sarnai* are also used for conveying the *dúbáru* across the river as required.

The small *sarnai* are used for getting from rock to rock in the rapids. A *mullah* who uses one of them ties it loosely round his waist, so that he shall not under any circumstances lose it; he then puts the inflated hind legs of the skin between his legs and, clasping the neck in his arms, throws himself into the water. He guides himself with his legs and one arm. By means of these small *sarnai* the *mullah* can get to any part of the river, no rapid being too bad for them. The second photo published this month shows a typical reach of the Tons with stranded sleepers. It is taken at the turn in the river above the Tiuni Bridge.

A Ranger generally accompanies the *ghal*, as the total number of sleepers launched, is called collectively. The sleepers are eventually caught at Dákpathar on the Jumna, where there is a boom * across the river. At Damog, about 10 miles above this, the sleepers are only re-launched and sent down gradually, so that too many

* This boom is described in Schlich's Manual of Forestry, Vol. V., p. 393.



Negative by P. H. Clutterbuck.

FLOATING ON THE TONS RIVER.

may not reach the boom at a time. Sometimes heavy rain occurring at such a time, causes the river to rise and carries down so many sleepers, which before were stuck, that the boom has to be re-opened for fear of its breaking with the strain, in which case a great deal of extra expense is incurred in recapturing the sleepers further down the Jumna, and many get lost altogether.

Dákpathar is about 2 miles below the Tons-Jumna Junction, and about 57 from the mouth of the Mautárgádh. The cost of floating for this length varies from about 1·75 to 2 pies per piece. The time occupied is about $2\frac{1}{2}$ months. On an average about 99 per cent. of the original number launched arrive safely. A certain amount get broken in transit. Some, too, are stolen since the right bank of the Tons for the greater part of the way is not Government territory, and is therefore difficult to patrol.

Last year (1900), 188,000 pieces were sent down, of which 175,000 were metre-gauge sleepers. A contractor took up the work of conducting the floating from the Jarár depôt to Dákpathar for 9 pies per piece. The weather was favourable, and he has profited by the contract.

III.—Floating by Rafts.

Below Dákpathar rafts can be floated, so the sleepers are taken on from there in that way. Each raft, called a *bera*, contains 328 metre-gauge sleepers, formed of two halves, side by side, each called a *salak*. On the raft an additional 24 sleepers are carried. Each salak is made up of a double layer of sleepers placed crossways, 64 in each layer, with 32 sleepers lying in double rows on the top, firmly bound with ropes made of *bhaber* grass, *Ischmœnum anjustifolium*. About $2\frac{1}{2}$ maunds of this are required for each raft. It costs Re. 1 per maund. The rafts steered with poles are floated 26 miles down the River Jumna to Tájawála, where, entering the Western Jumna Canal, they are taken 160 miles along it to Delhi. The majority of the sleepers go to Delhi, but a few are sent to other places by rail from Abdullapur Station, which is 27 miles along the canal from Tájawála. The canal fees are $1\frac{1}{3}$ annas per metre-gauge sleeper. The cost of rafting is Rs. 16-2-per raft of 344 sleepers, so the total cost of floating the sleepers from the Jarár depôt to Delhi, about 248 miles, is under $3\frac{1}{2}$ annas per sleeper.

Statement showing cost of floating per metre-gauge sleeper from Jarár Depôt to Delhi, 248 *miles* :—

	As.	p.
Telescopic floating from Jarár Depôt to the Tons, $5\frac{1}{2}$ miles, at 7·5 pies per piece	0	7·5
Floating from the mouth of the Mautárgádh to Dákpathar, at 2 pies per piece	0	2
One per cent., lost in transit, at Re. 1-8 divided among 99 per cent. which reach safely, each	0	3
Rafting including rope	0	10·5
Canal fee	1	4
Establishment and Miscellaneous	0	1
Total ...	3	4

Visit to the Forest of Fontainbleau, France.

By E. McA. Moir, I.F.S. (*Retired*).

In connection with the Forest Congress, held at the late Paris Exhibition from the 4th to 7th June, an excursion was arranged to the famous Forest of Fontainbleau, situated about 50 miles to the south of Paris, on the Lyons line of Railway.

Accordingly, on the 9th of June, about 100 members of the Forest Congress started from the Lyons Railway Station at 9 A.M., and, after a pleasant run, arrived at Fontainbleau about 10-30.

The day was a perfect one, with bright sunshine and a cool breeze, and the country passed through, consisting of undulating fields, all covered with splendid crops of wheat, potatoes, clover, &c., interspersed with many fine orchards and vineyards, also with many picturesque patches of wood and plantations, was looking its best, and tended to put everyone into the best of spirits.

On arrival at the station of Fontainbleau, we were met by M. E. Reuss, Inspector of Forests in Charge, supported by his Guard Général, together with several Brigadiers and Forest Guards, all attired in their smartest uniforms, in honour of the important occasion.

Outside the station we found five or six large four-horsed brakes or waggonettes awaiting our arrival, and, after being each presented with a neatly bound map of the forest, we soon settled down into our respective places, and at once started off on our tour of inspection of the most important parts of the famous Forest of Fontainbleau.

As the forest is a most extensive one, and our time being limited to six or seven hours, we naturally only attempted a drive through the principal and most important parts, situated to the north of the town of Fontainbleau.

We had, therefore, no time to make any very minute observation of the state of the forest with a critical eye, and for the following information I am mainly indebted to an interesting and concise pamphlet on the Forest of Fontainbleau, compiled by M. Reuss, and of which we each received a copy, but which, I regret to say, many members being so enchanted with the beauty of the scenery, failed at the time to study.

As regards the history of the Forest of Fontainbleau, it was formerly known under the name of the Forest of Bière, and formed part of an extensive forest area, occupying the valleys of the Loire and Seine, and of which the Forest of Orleans and Montages are the other most important remnants still in existence.

This forest formerly constituted the special hunting ground of the King of France, and especially of Louis XIV, and was long considered the private property of the Crown.

The French Court usually proceeded to Fontainbleau every autumn with the object of hunting, hawking, &c., and many a gay

and festive scene was doubtless enacted within its silvan precincts.

After the French Revolution the forest became the property of the State, and is now considered, on account of its extent and proximity to Paris, one of the most important forests under the charge of the French Forest Administration.

The Forest of Fontainbleau is situated on the left bank of the River Seine, in the departments of the Seine and Maine, and forms part of the conservatorship of Paris, where the conservator has his headquarters.

The area of the forest, which is stated to have remained about the same during the last 300 years, is 17,000 hectares or about 42,500 acres, and this includes an area of about 800 acres devoted to military rifle and artillery ranges, &c.

The geological formation of the forest consists of what is known as the Fontainbleau sandstone belonging to the Miocene period, the deposit having a thickness varying from 100 to 150 feet.

Overlying the sandstones in many places are found beds of recent clay, and marls of various degrees of thickness and extent.

The whole area of the forest has been much modified by the action of water, and is therefore much cut up into small valleys with intervening plateaux, and low hills called "monts," which, however, only attain a height of 150 to 450 feet above the level of the Seine.

On the whole, the result is a dry and not very fertile forest soil, except in the places where clay and marl predominate, in which spots it may be said to be of good quality.

Owing to the generally dry and pervious nature of the soil, there are few perennial streams to be found in the Forest of Fontainbleau, the only one of importance being "La Madeleine" which, after filling the lakes in the old Palais grounds, contributes to the town water-supply.

All the other streams are either absorbed locally early in the summer or form small marshes, most of which also dry up during the hot weather.

As regards the suitability of the soil for forest growth, it may be said to be of a medium quality, except where the clay and marl predominate, and there the trees attain fine dimension.

The vegetation of the Forest of Fontainbleau consists principally of the following species:—

Robur Oak (*Quercus sessilifolia*) is the most important, and constitutes about 50 per cent. of the whole forest vegetation.

After the Oak comes in importance the Scotch Fir (*Pinus sylvestris*), which was introduced about the year 1786, and has become now quite naturalized in this locality.

This species reproduces itself with the greatest ease, so that the treatment of the Pine portions of the forest, as far as natural reproduction is concerned, presents no difficulty.

Although about 13,000 acres of pure Scotch Fir forest exists, it is satisfactory to note that up to the present no particular damage has been caused by any serious invasion of insect pests, but as this is to be feared, steps are now being taken to introduce a mixture of Beech along with the Pine. After the Oak and Scotch Fir, the Beech (*Fagus sylvatica*) may be said to be the next and most important forest species, as it constitutes about 15 per cent. of the remaining forest growth.

The timber and fuel of this species are not, however, considered of very good quality at Fontainbleau, and it is principally as a soil-improver and nurse, that its growth is encouraged.

The other species which constitute the main forest vegetation at Fontainbleau are Hornbeam (*Carpinus Betulus*), Birch (*Betula alba*), Poplar (*Populus alba*), Elm (*Ulmus effusa*), Maple (*Acer campestre*), Ash (*Fraxinus excelsior*), &c.

The secondary vegetation and undergrowth of the forest consists of various small trees and shrubs, of which the principal, Juniper (*Juniperus communis*), attains a height of 15 feet, and the timber is sufficiently large to be used for carving purposes. The following shrubs and plants are very common throughout the whole forest, *viz.*, Broom (*Cytisus scoparius*), Heath (*Calluna vulgaris*), Bracken (*Pteris aquilina*), &c.

As regards the areas covered by the principal forest species, they are distributed as follows:—

The Oak, with undergrowth of Beech and Hornbeam, covers about 46 per cent., the Scotch Fir about 20 per cent., and the remaining 24 per cent. consists of mixed forest.

The central part of the forest, *i.e.*, the portion situated to the north of Fontainbleau, and which may be compared to the kernel, has always been treated on the high forest system.

In the other deciduous parts situated to the north and south of the principal forest area, the system of Coppice with Standards was introduced about 100 years ago with the main object of meeting the increasing fuel requirements of Paris, to which place the fuel is easily and cheaply transported by means of barges, plying down the River Seine.

The following interesting natural facts regarding the Forest of Fontainbleau may be recorded, and they have had an important effect on the condition of the forest vegetation during the last 20 years.

The most serious damage was that caused by the severe frost and snow during the winters of 1879 and 1880, and the effects were naturally more severe in the Pine portions of the forest, where large numbers of trees were broken by the weight of the snow.

Besides the Pine, which mainly suffered, various other species were more or less damaged by the severe frost of those two winters, the only species which really escaped being the Birch, which was hardy enough to escape all damage. The result of the injury done

by the frost during these two winters was that the sanctioned Working Plan prescriptions were completely upset, and an immense quantity of wood was thrown suddenly on the market, and, as a matter of course, had to be disposed of at very low rates.

A good deal of damage has also been done to the Forest of Fontainbleau from time to time by violent storms, notably by those of the winters of 1827, 1893, and of the 14th of February 1900, on which occasion about 12,000 Pines were blown down, the deciduous tree, as usual, having fairly well escaped.

Owing to the comparatively dry and inflammable nature of the Pine portions of the forest, and to the fact that it is much resorted to by visitors, also that numerous main roads traverse it, along which innumerable motor-cars are continually flying, it is not to be wondered at that fires are of frequent occurrence, due to the carelessness of visitors. The areas burnt during 1892, 1893, and 1897 were respectively 475, 100, and 875 acres, and these were considered most serious fires from a French Forest Officer's point of view.

As they, however, only represent a failure of about 1½ per cent. of the whole area protected, Indian Forest Officers would, I think, consider themselves uncommonly lucky in most years to escape with such good results.

Again, the action of lightning is said to have caused considerable damage, especially to the Oaks, and many trees injured by *lightning are frequently met* with all over the forest.

The trees struck are principally Oak and Fir, and it is worthy of note that Beech trees are seldom injured.

In olden times the Forest of Fontainbleau seems to have been subject to much maltreatment, and wholesale pilfering took place by the neighbouring inhabitants, and this was systematically connived at by the underpaid and corrupt officials of those times.

This unsatisfactory state of affairs was, however, to a great extent put a stop to as early as the year 1664 by a vigilant minister of Louis XIV called Colpert, who undertook the proper demarcation of the forest, and inaugurated some important Forest regulations for its better management and treatment.

The result of these praiseworthy reforms had a most beneficial effect on the welfare of the forest, and it may, therefore, be said to have come under conservancy treatment, more or less strict, from an early date.

Up to the time of Louis Philippe, *i.e.*, 1835, the forest seems to have been generally treated on a system of selection felling, besides Coppice with Standards in a few places.

At this time, however, the old system was changed, and the method of seed-felling with thinnings in accordance with the new

teaching of the Nancy Forest School was fully established on a new scientific footing.

No detailed Working Plan was, however, framed till the year 1861, when a special Working Plan Commission of Forest Officers drew up an elaborate plan, the main features of which were as follows:—

54,310 acres were laid down to be treated as high forest with regular seed-fellings, the rotation being fixed at 120 years, this being divided up into five periods of 25 years each.

4,045 acres were laid down to be treated on the Coppice with Standards system, having a rotation of 30 years.

And, finally, 4,067 acres were to be treated on no particular system at all, but left practically to a state of nature, the object being to meet the æsthetic or picturesque tastes and ideas of the numerous tourists and artists who resort to this forest during the summer months.

This well-considered and elaborate Working Plan was closely followed till the year 1880, when the devastation caused by the frost and snow already referred to, necessitated the plan being considerably deviated from, and the substitution of a provisionary Working Plan pending the thorough revisal of the regular Working Plan.

This arrangement continued for 12 years, which shows the sometimes unavoidable instability of elaborate forest working schemes, and during that period the damaged portions of the forest were gone over by a series of improvement fellings, planting, &c., so as to bring them as far as possible into a proper state for the Revised Working Plan Scheme. After very careful consideration the Revised Working Plan came into force during 1892, and under its provision the forest is now sub-divided and worked as follows:—

1*st.*—Area to be treated as high forest, and comprising about 18,097 acres, and consisting of the best portion of the deciduous forest.

This has been divided into nine Working Circles, the whole to be managed on a rotation of 120 years.

2*nd.*—Section consisting of the resinous forest and comprising about 8,230 acres, divided into five Working Circles, to be worked on a rotation of 72 years.

3*rd.*—Selection felling or jardinage portion, comprising 7,457 acres, divided into five Working Circles, to be worked on a rotation of 7 years.

4*th.*—The Coppice with Standards portion, comprising 4,392 acres, to be managed on a rotation of 30 years.

5*th.*—The picturesque or æsthetic portion, comprising an area of 4,040 acres, to be managed according to fancy considerations, or almost left to nature.

It may be observed that the object of the first section is to provide well-grown timber for building purposes and railway sleepers, for which there is an ever-increasing local demand.

The object of the second section is to furnish cheap and plentiful fuel for Paris, where the demand is steadily on the increase, owing to the excessively high price of coal, which at present is selling at £3 per ton.

As regards the third section managed under the system of selection felling or jardinage, the reason for this mode of treatment is that the portions so treated are situated on rocky and inferior ground, and thus unsuitable for other more regular treatment of high forest.

With regard to the system of Coppice with Standards, it might be expected that, taking into consideration the dry nature of the soil of Fontainbleau, it is somewhat surprising that the system *should be* maintained *at all*, but the explanation given is that it is useful for the fuel-supply, and if it is finally decided to convert some of the coppice areas into high forest later on, the presence of the standards will materially assist towards a satisfactory transformation.

In the fifth or æsthetic part of the forest, which naturally contains all the most picturesque spots, much appreciated by artists and tourists, are to be found most of the finest Oaks and other fine trees, some of which bear historical names, such as *Clovis*, &c.

None of the picturesque trees are, of course, ever felled, but are allowed to decay and fall naturally, and one ancient Oak, which had recently collapsed, measured 16 feet in girth and about 100 feet in height.

The Forest of Fontainbleau is noted for the completeness of its system of roads and paths, being traversed by about 80 miles of natural and departmental roads, and 1,200 of main forest roads, all of which are kept in splendid order.

The most romantic of these roads is what is called the Circular Road, which describes a circle round the Palace of Fontainbleau. It has a radius of five miles, and commands some fine vistas and views of the surrounding forest, and is much appreciated by visitors. As regards the question of the disposal of the game in the Forest of Fontainbleau, it is sold by auction on a five years' lease, and fetches about 8 annas per acre per annum.

This high price is, of course, due to the proximity of the Forest to Paris, and as good shootings are scarce in France as compared with England and Scotland, great competition takes place at the auction sales.

In addition to the ordinary small game, such as pheasants, partridges, woodcock, rabbit, hares, &c., there are a good many fallow and roe-deer, the former much resembling the Indian cheetal.

There are also a few wild pigs, and during severe winters, wolves sometimes frequent the forest, when exciting and elaborate hunts are instituted to ensure their capture.

The following is a statement of the average annual outturn of the Forest of Fontainbleau in material and money during the years 1889 to 1898 :—

Outturn of timber, fuel, &c., per annum,	35,666	Cubic metres.
Or about	1.160,000	Cubic feet.
And the value of the above in money is estimated at	4,22,500	Francs.
To this must be added the revenue from miscellaneous produce, including the game lease, *viz.*	82,362	
Grand Total ...	5,04.862	Do.
Or about ...	3,15,539	Rupees.

The average annual expenditure stands thus during the ten years referred to :—

Spent on works of improvement, such as roads, plantations, &c.	56,156	Francs.
Cost of Establishments	30,747	Do.
Rates and taxes	17,031	
Grand Total ...	103,934	Do.
Or about ...	64,958	Rupees.

The net annual revenue during the ten years referred to therefore amounts to Rs.2.50,581.

After making reduction for the absence of receipts from the 4,040 acres of æsthetic forest, Public Works fees, grants, &c., the net annual average outturn of the Forest of Fontainbleau stands at 2·37 cubic metres per hectare, or about 30 cubic feet per acre.

As regards the annual net revenue of the forest, it amounts to 28·17 francs per hectare, or about 7 rupees per acre.

This result may be said to be very good as compared with the net annual revenue per acre from many Indian forests, but as far as a comparison with other French forest goes, it is considered considerably below the average, as some of them render as much as 50 francs per hectare, or about 12 rupees per acre per annum.

I must not forget to mention that when we had completed about half of our tour of inspection, we arrived at a snug restaurant, situated in the middle of the forest, where we were provided with an excellent breakfast to which we all did ample justice.

During the repast a band of seven or eight forest guards enlivened us with some of the old Nancy Forest School tunes rendered in a lively manner on the "cor de chasse."

After breakfast several appropriate speeches were made by the forest representatives of six or seven different nations, and these were much applauded.

Mr. R. Fisher, our representative, in a concise and lively manner, enumerated the blessings and advantages the Indian forests have derived from our intimate connection with the French scientific teachings and practical forest management, and his speech was well received and applauded.

After completing our tour of the forest, we ended up with a visit to the ancient Royal Palace of Fontainbleau, which was formerly one of the principal residences of the French Monarchs, and afterwards of the Emperor Napoleon. This Palace is beautifully situated in the middle of the forest, and about three miles from the River Seine. Immediately to the north of the Palace lies the small town of Fontainbleau, containing about 13,000 inhabitants, and it forms a favourite summer resort of visitors, and specially of artists from Paris.

The Palace is a most extensive building, occupying the four sides of a large square, and consists of numerous suites of apartments, banqueting halls, theatre, and other chambers of all shapes and sizes, and ornamented and decorated in the most costly manner.

The floors consist of polished oak and marble, and the wall decoration consists principally of ancient tapestry, mirrors, carvings, and gildings of great value and elaborate designs.

There are also numerous pictures, statues, and other works of art, all executed by the most renowned French and Italian artists of bygone days.

The State apartments of the famous Queen Marie Antoinette were the most interesting shown to us, and contained many objects of the greatest interest and value.

Since the fall of the Empire in 1871, the Palace of Fontainbleau has not been used as a State residence, and is only now maintained as an interesting show place for the gratification and entertainment of its numerous visitors.

The Palace grounds are of a most extensive and picturesque description, and consist of elaborate flower beds, lakes, alleys, all interspersed with clumps of exotic trees and shrubs of numerous species, and ancient French landscape gardening may be here seen in its greatest perfection.

Having completed our tour of the Palace and grounds, we again proceeded to the Railway Station, and reached Paris at 7 P.M., much pleased with our interesting and instructive excursion, the one great regret being that more of our old Indian Forest friends (who were doubtless at the time engaged with dry "dufter" work, or struggling with Forest conflagrations) were not fortunate enough to accompany us, but we sincerely hope that they may some day all enjoy a similar pleasant and instructive excursion on their final return from their sojourn in the forests of our great Indian Empire.

The Forests of Arrakan, Burma.*

By E. P. Stebbing, I.F.S., F.E.S.

The Export of Timber from the Arrakan Forests.—I have shown that my observations and enquiries at Maungdaw and in the Prooma Kal led me to the discovery that a large amount of timber was being cut in the forest round these places, or perhaps I should say that these points and Akyab are, (with possibly some others,) the centres at which the timber is collected and loaded into ships for export, and the question now arises as to what becomes of this wood. One has not to go far afield to obtain the answer. The wood is cut up and exported in the form of beams, planks, scantlings, posts, &c., and also as dugouts. These latter are loaded into big balam boats (boats built of planks to a certain extent), and exported to Chittagong and elsewhere. A large number of these Arrakan-made dugouts are always in evidence in the Chittagong Division. The balam boats go down to Arrakan to engage in the paddy trade with the Arrakan Mills, and on their return load up with dugouts.

The beams, planks, &c., are loaded up into brigs and schooners and carried to Chittagong, Barisal, Chandpur, Narainganj, Zalokadi, Bohar, Shahabajpur, &c., the ship returning to Chittagong from these places in many cases loaded up with jute.

My enquiries have led me to form the opinion that it may be taken as an almost indisputable fact that only a portion of this timber has paid royalty to Government, since the Deputy Commissioner at Akyab states that only Rs.4,000 odd revenue are made out of his forests per annum, and this export trade requires to be most carefully enquired into.

The woods chiefly exported are Pyinkado (*Xylia dolabriformis*), Jarul (*Lagerstrœmia Reginæ*), Khoira (*Acacia Catechu*), and Garjan (*Dipterocarpus tuberculatus*). No royalty is said to be leviable on other classes of woods, although they are also exported. Canes are also exported from these forests. Arrakan wood is plentiful in Chittagong, and hundreds of Jarul and Khoira posts undersized (*i.e.*, under 4 feet 6 inches in girth) and otherwise, are to be found in the southern portion of the district.

The jute brought to the Chittagong Port is consigned to Messrs. Ralli Brothers and M. David & Co., and both these firms, I understand, are engaged in this Arrakan wood trade, as are also Messrs. Bullock Brothers and the representative of Messrs. Ahmuty & Co., and several native firms of the town. I believe these firms, most of the European ones at any rate, simply buy up the wood in large quantities, either at Maungdaw, Akyab, or at one of the other places of export in Arrakan or at Chittagong itself, and have nothing to do with the extraction of the trees from the forest or with the payment of royalty thereon. That the export is considerable will be seen from the above facts and from

* Begun in February Number, 1901.

certain figures which I obtained from the Collector of Customs of the Chittagong Port. These latter, however, represent but a portion of the timber extracted, as the wood consigned to the other places in Eastern Bengal mentioned above never comes into the Chittagong Port, nor do many of the balam boats which come up by the inner route through the canals.

The figures speak for themselves and are sufficiently startling. During the year 1898-99, 22·6 tons of Iron-wood, valued at Rs.2,036, 93·5 tons of Jarul wood, valued at Rs.5,612, 20 tons of other wood, valued at Rs.806, and 5 tons of canes, valued at Rs.1,001, were imported into Chittagong, or a total value on the imports of Rs.9,455.

During 1899-1900, the imports were:—

				Rs.
Iron-wood	...	... 78	tons =	4,680
Jarul wood	...	... *203*	„ =	*11,598*
Other wood	...	... 34	„ =	1,690
Canes	...	... $7\frac{3}{4}$	„ =	906

or a total value on the imports of Rs.18,874, *i.e.*, double that of 1898-99.

During the present year 1900-1901 up to June 18th, we have the following figures:—

				Rs.
Iron-wood	...	... *nil*	tons =	*nil*
Jarul wood	...	... 612	„ =	31,540
Other wood	...	... $6\frac{1}{2}$	„ =	312
Canes	...	... 2·6	„ =	394

or a total value of Rs.32,246, *i.e.*, *almost* double the figures of 1899-1900, and that for less than three months (*i.e.*, from April 1st), although possibly the most important months of the year. It will also be found that all the iron-wood exported in the form of beams, posts, and planks comes from Akyab Port, and this leads me to the supposition that this wood is cut in and brought from the Pyinkado Forests, situated to the south of the Kolandyne river, *i.e.*, those visited and reported on by Dr. Schlich. This would show that traders have started cutting in these forests.

As far as I have been able to learn, the Pyinkado Forests have not as yet been called upon to supply sleepers on a large scale for the Assam-Bengal Railway, whose terminus and head-quarters are now at Chittagong. From the customs returns of the Port of Chittagong, I have, however, discovered that 60 tons of Pyinkado sleepers, valued at Rs.3,600, were imported into Chittagong from Akyab in 1899-1900 for this railway, probably long sleepers to be used for point-crossings. It is probable, however, since European firms are now engaging in the trade, that it will not be long before an attempt is made to work the iron-wood forests with the view of under-selling the Pegu-Pyinkado sleeper at present used on the line.

In addition to sleepers, the Railway Workshops also make use of Jarul and other woods, paying Rs.60 to Rs 65 per ton for the Jarul.

(*To be continued.*)

III.—OFFICIAL PAPERS AND INTELLIGENCE.

The Teak Trade of Bangkok and District.*

By Mr. Consular-Assistant Carlisle.

Teak. Teak shows a large increase in the year, the export rising from 22,692 tons, valued at 168,605*l.* in 1898 to 36,616 tons, worth 323,867*l.* in 1899, an increase of 13,924 tons and 155,262*l.* These are the official figures, but, as in previous years, they differ considerably from the statistics compiled by firms directly interested in the

* Diplomatic and Consular Reports, Siam. The trade of Bangkok and District for the year 1899, Foreign Office, 1900. Price, Threepence.

trade. The latter calculate the 1899 export to foreign ports as 38,661 tons, that for the previous year having been 26,495 tons, which would make the increase 12,166 tons. The year may be considered on the whole a very good one for the exporter, for, although the floating season was again not altogether satisfactory, the export was large, and prices were high. Bangkok was, however, at a disadvantage in the matter of high freights, paying as much as 3*l.* as against 2*l.* from Burma. The local selling value of European timber was about 10*l.* per ton.

Destinations of Export.

Taking the export to be 33,661 tons as above, it was distributed as follows :—

To	Quantity.
	Tons.
Europe	1,1576
Singapore	3,784
Hong-Kong...	13,261
Bombay	8,678
Saigon	317
Other Countries	1,045
Total ...	38,661

Of the direct shipments to Europe, 7,617 tons went by chartered sailing vessels, of which 12 were loaded during the year. The Danish East Asiatic Company's steamers carried the remainder. It is impossible to say what proportion of the shipment to Singapore was destined for the European markets, but it may be safely estimated at not less than two-thirds. In the same way, it is impossible to say how the shipments to Hong-Kong were ultimately distributed.

Export for last ten years.

In order to give an idea of the average output, the exports for the last ten years, as stated in the annual custom-house *returns*, follow :—

Year.	Quantity.
	Tons.
1890	38,735
1891	16,100
1892	14,637
1893	30,089
1894	57,719
1895	48,994
1896	49,690
1897	38,767
1898	22,692
1899	36,616

British share of the trade.

Great Britain continues to hold by far the largest and most important share of the teak export business and of the teak forests. A forest lease, however, has recently been granted to a Danish and another to a Chinese firm.

Prospects of the trade.

The prospects for the current year are promising. The output during the past six months has increased, and European values have held up well.

Forest reform.

Teak merchants in Siam are naturally manifesting considerable interest in the new precautions for forest preservation, which are being taken by the Siamese Government with the advice and assistance of Forest Officers from Burma. The Government is now bringing the teak forests of Siam under systematic control. They propose in effect to considerably limit the area of forests now being worked, and to charge rentals in addition to the present royalties. They now issue the forest leases themselves instead of allowing the local "Chaos" or chiefs to grant them as formerly. They are increasing, too, the limit of girth of trees which may be felled, so as to bring the practice more in line with that obtaining in Burma. The effect of all these measures will, no doubt, be to somewhat limit the teak output while preserving the lives of the forests. No diminution from this cause is likely to be felt for some years yet, however.

General remarks.

An interesting difficulty of the trade is the increasing dearness and scarcity of elephants in the north. This is partly due to the fact that most of these animals used to come from the east bank of the Mekong, and that since the French annexation of that region the officials have discouraged their export in every way. At the same time, the constant demand for elephants on the Burma side drains them out of Siam.

Other parts of the country, however, still contain numbers of wild elephants, and, it is said, that a Chinese firm is getting up a considerable herd from the Malay Peninsula for work in the north. It will be interesting to see if this proves a remunerative experiment. It is probable that in time carriage by carts and mechanical means of haulage will be largely adopted.

The consumption of teak appears to be increasing regularly. Besides its use for ship-building and railway rolling-stock there is an increasing and noteworthy demand for it in Europe for house-building and furnishing. The growth of European navies means a corresponding demand for teak, despite the desire to use as little wood as possible in the construction of war-ships. For sheathing and armour backing it seems to be necessary, and the amount of teak consumed in building a battle-ship is said to be about 1,000 tons. Teak merchants suggest that the result of "Belleisle"

experiments should be to minimise the danger to be apprehended from the inflammability of teak timber.

The bulk of the teak supply of the world comes of course from Burma, Siam being a long way second. The prejudice against Siam, as compared with Burma teak, still holds good in great part, though many experts say that Siam timber is now for all practical purposes as good as Burmese. The British Admiralty, however, continue to reject the Siamese material. One local source of consumption has been closed, that of the Royal Railway Department, which has now erected a small mill and cuts its own hard wood.

Concerning Elephants.

In the January Number of the *Indian Forester*, LONG TOM sums up his curious article on "Cowardly Elephants," with the sweeping assertion that the elephant has always appeared to *him* to be "the slowest in thought of all animals that are trained by man, and to be absolutely lacking in reasoning power * * *." No doubt, a number of Forest Officers, who are *friends of the* patient beasts that do so much work for us, (and that I think with sufficient cleverness,) will come forward to prove, at length, that elephants are quite as sagacious and as capable of reasoning, and even more so than many domestic quadrupeds—like the horse—of whose intelligence we generally hold a high opinion.

Leaving such authorities on the subject to discuss the question to its right conclusion, I would like to just throw in a few observations of my own, in order to add weight to such arguments as may be forthcoming in favour of elephants and their decided ability to think. Perhaps LONG TOM does *not mean his article* to be taken seriously, and, probably, wrote it to relieve his feelings after that old "female elephant" had smelt another dead green pigeon. But now that I have begun to write, I may as well go on for the sake of argument.

Firstly, it is beyond dispute that wild elephants show much cleverness, which is more of the nature of *thoughtfulness* than of common *instinct*. The way they collectively aid, or defend their young; the practical manner in which they choose their feeding grounds and travel by well-selected permanent paths from one

ground to another, just, as it seems, at the right time; the cunning manœuvres of rogue, —all go to prove this. So do the incidents befalling at any Khedda.

Then, in the tame state, can any other animals be found that are able to remember and understand so many different words of command as our working elephants? Those who have seen elephants at work in timber yards, at any rate in Burma, will call to mind how cleverly they stack timber, although the methods of stacking may not be uniform. In rafting sunken timber, an elephant will readily, at command, hold a sinking log at the surface of the water until it is secured to some that are buoyant. In such cases, all that an elephant does cannot surely be put down to blind force of habit!

In the Andamans a few years ago, one of the forest tramways ended at a steep "shoot," leading down to a tidal creek that was used for floating out Padouk. The logs were large and far too heavy to be handled by men. So an old elephant, Bisheswar Prasad by name, was employed daily, when the timber was brought in from the fellings, in turning each log round on its truck until it was in line with the shoot, and then sending it off with a butt from behind. Often he did this without guidance from his mahout, and he would do it *accurately* every time. Another elephant sometimes helped to put up rough bridges, and would lift a beam to the required height, and *hold it there* until it was secured to the uprights. I do not say that this elephant knew that a bridge was being built so many feet above flood-level; but he appeared to understand that his mahout wanted the beam lifted up and held in place for a certain time, and he patiently listened to and carried out orders without a mistake. There is no need to quote more instances of this kind, although there is no end to the variety of them. These two alone, with what I have written above, seem to me sufficient grounds for concluding that elephants either wild or tame are by no means "*absolutely* lacking in reasoning power."

GYOK-BIN.

VI.—EXTRACTS, NOTES AND QUERIES.

The Forests and Waste Lands of Ceylon.

By A. F. Broun, *Conservator of Forests.*

The area of uncultivated land in Ceylon exceeds 20,000 of the 25,365 square miles of country contained within the colony. The proportion of good forest in these 20,000 square miles is unfortunately small, the largest portion being taken up by scrub and by grass-covered stretches of country called *patanas*, which find their greatest development in the hills of the Province of Uva. The scrub is partly natural, especially so on the sea coast and in the arid sub-zone, and partly the result of a destructive

method of cultivation known as *chena*, which consists in clearing and burning jungle and in raising crops for two or three years on the area cultivated. Now that a careful control is exercised over this cultivation, nothing but small forest is felled; but not many years ago valuable forests were ruthlessly felled, and their ashes were utilised as manure for the crops which were raised; where such a system of cultivation has been in force, it takes years for the forest to take again a useful character. Usually a thorny scrub grows up, or, as is the case in the Eastern Province, a dense growth of thick grass (*Imperata arundinacea*) springs up, as in the moist districts; the ground gets covered up with *Lantana;* or, worse, because they are not soil-improvers, by *Hedyotis, Ochlandra stridula* or *Gleichenia linearis.*

The patanas were probably at one time covered with trees, such as will be described later on for the Park country, but fires and grazing have destroyed the majority of these, except in sheltered places, such as gullies or ravines.

The trees which are to be found on the patanas are, at higher elevations, *Rhododendron arboreum*, and from 4,000 feet downwards *Careya arborea* known in Ceylon as "Patana Oak," *Phyllanthus Emblica, Terminalia belerica, T. Chebula*, and *Pterocarpus Marsupium.* These are, with few exceptions, the only trees which can stand the heavy grass fires; but in the gullies, where they are more sheltered, other species, which are less robust and which are the same as those found in forests at the same elevation, are able to live and reproduce themselves.

In the backward state of the survey of the Island, it is not yet possible to state the area of the real forests, but they cannot much exceed 5,000 square miles, although the larger area is, for the present, set aside for reservation, which includes stretches of scrub and patana enclosed within the forests. The most important belt of forest stretches from the Northern Province, mostly between the centre line of the Island and the east coast down to the Hambantota district, but important blocks are also found scattered over the rest of the Island, chiefly in the Puttalam district of the North-Western Provinces, in the Western, Southern, and Sabaragamuwa Provinces, where are still to be found, in isolated blocks, the remains of what was at one time the extensive Singha Raja Forest.

The vegetation of the forests varies especially according to rainfall and elevation, and the forests can be classed according to the following zones and sub-zones :—

Dry Zones.—Rainfall, 35 to 70 inches.	Arid Zone.—Rainfall, 35 to 50 inches. Dry Zone Proper.—Rainfall, 50 to 70 inches.
Intermediate Zone.—Rainfall, 70 to 80 inches.	
Wet Zone.—Rainfall, 80 inches and more.	Low Country Zone, from sea-level to 4,000 feet. Mountain Zone, above 4,000 feet.

The Dry Zone.—This includes about three-fifths of the Island, *viz.*, the whole of the Northern, North-Central and Eastern Provinces, the Puttalam district and portion of the Kurunegula and Chilaw districts, the North-Western Province, the northern part of the Central Province, about two-thirds of the Province of Uva, the Hambantota district of the Southern Province, and the Kolonna Korale of the Province of Sabaragaumwa. The Western Province is therefore the only one of which no portion enters in the dry zone. The *Arid Zone* occupies the North-Western end of the Island in the Puttalam, Manur and Jaffna districts, and the south-eastern in the Hambantota district. The characteristic trees and shrubs of this sub-zone are *Salvadora persica*, *Azima tetracantha*, and *Acacia eburnea* near the coast, and *Acacia planifrons* on the Island of Mannar. The woody vegetation is usually shrubby and thorny, being represented by *Carissa spinasum*, *Zizyphus Jujuba*, *Z. Œnoplia*, *Z. rugosa*, *Randia dumetorum*, *Flacourtia Ramontchi*, &c. Further from the coast the forest vegetation is composed of the same species as of the forests of the dry zone proper, but the trees are usually smaller and the undergrowth is composed mainly of *Memecylon* and of *Stenosiphonium Rusyselianum*. The Palmyra palm (*Borassus flabelliformis*) is found on sandy soil both in this sub-districts, especially in the Jaffna Peninsula.

The forests of the *Dry zone* proper are the most important to the forester, not only because they are the most extensive, but also because they contain most of the valuable timber trees. The most important of these are satin wood (*Chloroxylon Swietenia*) found on sandy soils, and attaining its best dimensions in the Puttalam and Batticaloa districts; Ebony (*Diospyros Ebenum*), which prefers rocky, undulating ground, and which, although found occasionally in the wet, low country, is most abundant in the Northern, North-Central, and North-Western Provinces, and in the Erincomalee and Matabele districts; Palu (*Mimusops hexandra*), which is found on more clayey soils from the north to the south of the Island. It attains an enormous size, and grows best, if anywhere, in the Northern Province. *It is one of the iron woods of commerce.* Trincomalee wood (*Berrya Ammonilla*) is found in moist but well-drained places. It extends into part of the wet zone, but the trees are found in the eastern portion of the Province of Uva. Millu (*Vitex altissima*), one of the strongest Ceylon timbers, extends also into the wet zone, where it is not uncommon; but, like the Berrya, it is a much finer tree in the dry zone, especially in the Eastern Province. The same may be said of Ranai (*Alseodaphne semecarpifolia*), although it is not so common in the wet zone as Millu. The Ebenaceæ are (apart from Ebony) represented in this zone chiefly by *D. ovalifolia*, while *D. crumenata*, *D. oocarpa*, *D. Embryopteris* and *D. montana* are also found abundant in certain localities, and *Maba buxifolia* is a very small tree which is by no means uncommon even in the arid

zone. Of the Guttiferæ we have chiefly *Garcinia spicata Calophyllum Burmanni*, and near streams or in groves, planted before the memory of man, *Mesua ferrea*. The Dipterocarps, which are so characteristic of the low country wet zone, are almost absent, being only represented by *Vatica obscura* in moist soils in the Eastern Province and by *Hopea cordifolia* along streams in southern Uva and Sabaragamuwa. Among trees which are characteristic of this zone, the most common are *Polyalthia longifolia*, *P. coffæoides*, *Cratæva Roxburghii*, *Pterospermum suberifolium*, *Sterculia fœtida*, *Azadirachta indica*, *Walsura piscidia*, *Pleurostylia Whightii*, *Schleichera trijuga*, *Nephelium Longana*, *Odina Wodier*, *Cassia Fistula*, *C. marginata*, *Bauhinia tomentosa*, *Acacia leucophlæa*, *Acacia ferruginea*, *Gyrocarpus Jacquini*, *Eugenia Jambolana*, *Barringtonia acutangula*, *Adina cordifolia*, *Canthium didymum*, *Bassia longifolia*, *Terminalia glabra* (near streams and tanks), *Strychnos Nux vomica*, *Cordia Rothii*, *Stereospermum chelonioides*, *Euphorbia antiquorum*, *Sapium insigne*, *Hemicyclia sepiaria*, *Michodon zeylanicus*, *Holoptelex integrifolia*, &c. The most common shrubs are *Polyalthia Korinti*, *Allophylus Cobbe*, *Ochna squarrosa*, *Cassia auriculata*, *Alangium Lamarckii*, *Webera corymbosa*, *Randia dumetorum*, *Gmelina asiatica*, *Memecylon*, *Glycosmis pentaphylla* and *Dimorphocalyx glabellus*. Creepers and climbers are not so well represented as in the moister zones, the most abundant being *Hugonia Mystax*, *Ventilogo maderaspatana*, some species of *Vitis*, *Derris scandens*, *D. sinnata*, &c. The most beautiful orchids found in this zone are, without doubt, *Saccolabium guttatum* found in the Eastern Province, and *Vanda Roxburghii* which is found chiefly not far from the sea. and *V. spathulata* which are found chiefly not far from the sea. *Vanda parviflora* and *saccolabium Wightianum* are not uncommon, while a pretty little white ground orchid, *Habenaria pterocarpa*, is found in the rocky places. The ferns of this zone are not abundant, the *Adiantum caudatum* penetrating farther into the dry districts than any other, while *Hemionitis artifolia* and *Gymnopteris quercifolia* are found in dark and moist places, while on rocks grow *Cheilanthes mysorensis*, *C. laxa* and the tiny *Ophioglossum lusitanicum*.

In the *Intermediate zone*, trees of both the dry and the low country moist zone are to be found, such as *Berrya Ammonilla*, *Nephelium Longana*, *Mesua ferrea*, *Artocarpus integrifolia*, *Xylopia parviflora*, *Albizzia stipulata*, *A. odoratissima*, *A. Lebbek*, &c., and there are a few species which, although they are found elsewhere, can be said to be characteristic; these are *Filicium decipiens*, *Chickrassia tabularis*, and *Melia dubia*. *Terminalia belerica* attains an extraordinary size in this zone, in which are other gigantic trees like *Tetremeles nudiflora* and *Ailanthus malabarica*. Among the shrubs *Vitex Negundo* is probably the most characteristic. Another characteristic feature of this zone is the great abundance of creepers which cover the tallest trees and render forest operations extremely difficult. Some very handsome ferns grow in this zone,

the most noticeable being *Aspidium decurrens*, *A. subtriphyllum*, *A. cicutarium*, and *Adiantum lumulatrun*. The Park country of Uva can be included in this zone. It comprises the low lands of the eastern boundary of that province; and it has a quite characteristic flora, very similar to that of the Sub-Himalayan forests. The trees which are found here are found only on the patanas and occasionally elsewhere, the most noteworthy being *Anogeissus latifolia*, *Butea frondosa*, *Terminalia Chebula*, *T. belerica*, *Zizyphus xylopyra*, *Pterocarpus Marsupium*, *Miliusa indica*, *Sterculia colorata*, *Gmelina arborea* and *Diospyros Melanoxylon*. The undergrowth is, as in the Sub-Himalayan forests, mostly grass (*Imperata arundinacea*). Near water-courses the flora is that of the ordinary dry zone type.

The *Wet zone* includes the Western Province, the Province of Sabaragamuwa excluding the Kolonna Korale, the Galle and Matara districts of the Southern Province, the Hill districts of the Central and Uva Provinces, and about one-half of the Kurunegula and Chilaw districts of the North-Western Province, or, in a few words, the South-Western and South-Central portions of the Island. It is the portion which receives the full force of the south-west monsoon, and includes the higher lands affected by the north-east monsoon. The rainfall usually ranges from 80 to 200 inches, but it exceeds even this in some places, and rumour has it that in Eratere, to the south-west of Adam's Peak, it actually does not fall far short of 400 inches.

The low country wet zone is the country *par excellence* of the Dipterocarpus. In the Chilaw and Kurunegula districts and in the northern portion of the Colombo district, they are represented only by *Dipterocarpus zeylanicus*, but further south and east they increase in number and species until, in many cases, they form almost the entire forest. No doubt, several new species will have to be added, and ever since the first volume of Trimen's Flora has been published, fresh discoveries have been made, a case in point being the *Stemonoporus* (*? vatica*) *Lewisi*, which was found by Mr. F. Lewis of the Forest Department at about 1,000 feet altitude above Pelmadulla. The curious almost wingless fruit of *Shorea lissophylla* was also found near the Bintota river in the Western Province. The forest of this zone, where they have been saved, are to the eye the most magnificent of the whole island, the trees often reaching a height of 100 feet to the first branch. On this account the trees are often difficult to identify, and it is probable that many are still unnamed, especially as it is not always possible to hit on new species at the time when they are in flower or fruit. The most beautiful of these forests is probably the forest of the Hinidum Patu, in the Southern Province; in it the most important Dipterocarps are *Dipterocarpus hispidus*, which in the south almost replaces *D. zeylanicus*, *D. glandulosus*, *Shorea oblongifolia*, *Doona trapezifolia*, which extends up to about 3,000 feet above sea-level, *D. cordifolia*, *D. macrophylla*, *D. congestiflora*

which produces a valuable timber, *Hopea discolor* and *Vatica affinis.*

Vatica Roxburghiana is found near streams and in lands subject to inundation in the Western Province and in Sabaragamuwa, while *Vateria acuminata*, which also loves the neighbourhood of water, is found on more rocky ground. The Dipterocarps, which are able to ascend to an elevation of 4,000 feet, are *Doona zeylanica* and *D. Gardneri*, and *Stemonoporus Gardneri* which has been found up to nearly 5,000 feet.

Among the natural orders which are also widely represented, are the Guttiferæ, the Ebenaceæ, and the Sapotaceæ. The first-named is represented chiefly by the iron wood *Mesua ferrea* and *M. Thwaitesii* by *Calophyllum spectabile*, *C. Burmanni*, which extends into the dry country, *C. bracteatum*, *C. tomentosum*, *Garcinia Cambogia*, *G. morella* (the gamboge tree), *G. terpnophylla* and *G. echmocarpa*, which latter grows up to 6,000 feet elevation. The Ebenaceæ are particularly abundant in the forests of the Adam's Peak Range, and in the Pasdun and Hinidun Korales.

Ebony, as has already been mentioned, is found in small quantities in this zone, but the most important tree of this family, which is unfortunately almost extinct, the Coromandal or Calamander wood of commerce, *Diospyros quæsita*, is still found here and there in the Pasdun Korale and in the Hinidun Pattu. Attempts have been made for several years to obtain the fruit in order to propagate the species artificially, but, although rewards have been offered, none has been obtained.

The other most noticeable trees of this family are described by Mr. F. Lewis, who has made a special study of them. In the wet forests, extending from the mountain known as the Haycock into the Sabaragamuwa Province, the most noticeable example of the Ebenaceæ are *Diospyros posia*, *D. Gardneri*, *D. insignis*, and *D. Thwaitesii.* The first of these is found up to 3,000 feet altitude, while the last, though endemic, is restricted to the areas of high rainfall. *D. pruriens* is found very sparingly in the wet forests towards Adam's Peak, and in one place in the Western Province. A remarkable species, possibly a form of *D. Ebenum* locally known as "Kallu Kiria," occurs at the foot of the Rakwana hills, and is conspicuous by its black lace-like heart-wood, but little is known of its flowers or fruit. One of the most common, but valueless, of the order is *D. insignis*, which extends up to 2,000 feet altitude in the west of Ceylon.

The Sapotaceæ are also well represented, especially in parts of the Matora district. The most important are *Chrysophyllum Roxburghii*, *Isonandra lanceolata*, *Bassia fulva*, *B. neriifolia*, which lines the banks of rivers, *Palaquium petiolare*, *P. grande*, which extends into the mountain zone, and *Mimusops Elengi*, which is also found in the dry zone. Among the more noteworthy trees belonging to other natural orders, the following are characteristic

of this zone :—*Dillenia retusa, Wormia triquetra, Cultenia excelsa, Elæocarpus serratus, Kokoona zeylanica, Canarium zeylanicum, C. brunneum, Lasianthera apicalis, Pometia eximia, Campnosperma zeylanicum,* which in places forms almost pure forest, *Pericopsis Mooniana* near water-courses, *Adenantheræ pavonina, A. bicolar, Pygeum zeylanicum, Carallia integerrima, C. calycina* especially in the Galle district. *Anisophyllea zeylanica, Homalium zeylanicum, Symplocos spicata,* the three Myristicas (*M. laurifolia, M. Horsfieldia* and *M. Irya*). Various species of Cinnamomum and Litsxa are also abundant, and, among the Euphorbiaceæ, *Bridelia retusa, B. Moonii, Aporosa latifolia, A. Lindleyana, Ostodes zeylanica, Chœtocarpus castanocarpus,* and *Macaranga tomentosa* are the most common; while among Urticaceæ there are numerous figs, *Artocarpus intergrifolia, A. nobilis,* and *Trema orientalis.* Among the shrubs which characterise this zone may be mentioned *Humboldtia laurifolia, Mæsa indica, Agrostistachys longifolia, A. Hookeri, Ixora coccinea, Ardisia Moonii,* &c.

Most of the palms of Ceylon are found in the wet zone. The most important by far is *Caryota urens,* the toddy and sugar of which provide many jungle people with means of existence. The Talipot palm (*Corypha umbraculifera*) found in several forests, especially in the Kurunegula district, and is noteworthy for the enormous panicle of flowers which the male tree produces, and for its leaves, which are used for umbrellas, fans, mats, &c. The *Nipa fruticans* is characteristic of brackish waters, while several species of Calamus, with the help of their hooked tendrils, climb to the summits of the highest trees.

Among the characteristic climbers may be mentioned *Coscinium fenestratum. Ancistrocladus Vahlii, Entada scandens, Acacia concinna, Strychnös cinnamomifolia.*

The most beautiful orchid of this zone is the *Dendrobium macarthia;* and among the most interesting ferns may be mentioned *Gleichenia linearis,* which covers a large extent of country, *Blechnum orientale* and *Nephrolepis exaltata* which, after the first-named, are the most common. *Cyathæa sinuata,* which is only found in the Southern Province, *C. Walkerii,* the tree fern of the low country, *Thamnopteris Nadus,* the so-called Bird's-nest fern found growing generally on trees. *Asplenium rutæfolium, Diplazium lanceum, D. Schkuhrii, Aspidium Thwaitesii, Lastræa deparioides, Niphobolus Gardneri, Pleopeltis pteropus* (Varminor). *Toenites blechnoides* (in the Matura district), *Drymoglossum heterophyllum, Stenochlæna palustris, Polybotrya appendiculata, Gymnopteris variabilis, G. contaminans, G. subcrenata, G. quercifolia. Acrostichum aureum* (generally not far from the sea in swampy places), *Schizæa digitata, Angiopteris evecta, Ophioglossum pendulum,* and *Helminthostachys zeylanica, Botrychium ducifolium* and *Oleandra musæfolia* extend into the mountain zone.

The forests of this zone are by no means so large in extent as those of the dry zone; they usually occur in isolated blocks, covering ridges and separated by stretches of chena, or by paddy fields. The most important blocks are the forests that in former days formed part of the extensive Sinharaju forest; they are situated in the Galle district of the Southern Province, the Pasdun Korale of the Western Province, and the Kukulu Korale of the Province of Sabaragamuwa. The lower forests of the Adam's Peak Range also belong to this zone.—*Tropical Agriculturist.*

Political Famine.

A PLEA FOR FOREST CONSERVATION.

It is a curious thing that, while famine recurs periodically in India, and each successive instance of it covers a wider area, and afflicts a larger number of victims, symptoms are not wanting of the establishment of similar conditions elsewhere under our rule. Thus Lord Cromer recently had to report, in his optimistic account of the condition of Egypt, that the Nile flood, on which the prosperity of the country so largely depends, has failed beyond all former precedent. But he assumes that this ominous fact need

not be characterised in any stronger terms than those of "temporary inconvenience." It would be reassuring if one could share this optimistic view. As Lord Rosebery once said, "The Nile is Egypt, and Egypt is the Nile." If the result and necessary consequence of the Pax Britannica in Egypt is the drying up of the Nile, then the remedy of peace is worse than the disease of anarchy. Peaceful starvation has not much to recommend it, in the long run, above turbulent, if fluctuating plenty.

We have recognised the existence of the serious danger involved in a dwindling Nile, and the great dam which we are constructing at Assouan is a proof of the recognition. This great work is a conscientious attempt to meet a great danger. But it only deals with a symptom, and does not attempt to cure the disease. It is obvious that if the Nile flood reached the levels registered in Pharaonic times on the rocks at Silsilis, there would be no need for the dam. Ample supplies of water would reach every part of the delta, if the torrents which filled Old Nile again brimmed from bank to bank. But the one fact which comforts us is this: That the supply is steadily dwindling, and that, if the causes of the desiccation are not ascertained and removed, some day the river will follow the example of rivers further east, will flow below the surface of the ground, and will no longer fertilise the country the population of which has destroyed its sources. This has already happened in the Sahara, where the courses of the rivers are only to be seen in an occasional oasis, where the unseen current is near enough to the surface to nourish a few palms and thorns, and the scanty herbage beneath them. Even so late as Roman times, North Africa was the granary of Rome; showing that the moisture and fertility of the country were in excess of what may be found there now.

The Congo, with its bed as yet protected by dense rain-condensing forests, recalls the conditions which once used to fill the Nile. Vegetation there has baffled the natives with their ineffective tools, and the river is probably as full to-day as ever it has been since man lived on its banks. But this condition of things is nearly at an end. The stone age is over, and tons of axes and hatchets of iron and steel are pouring into the country. The demand for rubber, for timber, for fuel for railways and river seamboats, and for the endless wants of this iron age, is consuming the forests. At present they seem inexhaustible, and merely a bar to the spread of civilisation. The Belgian rulers of the Congo Free State are in the position of a spendthrift heir, with a vast heritage before them, to waste and do what they like with, in the primeval forest which covers the land, and shields it from the rays of the sun. Sooner or later, the present system of piracy and plunder must give way to agriculture, and the enormous profits to be secured by working virgin soil, enriched with the fallen leaves and trees of thousands of years of decay, will attract millions of prosperous cultivators. As long as the balance is

preserved between clearings and forest, and the precipitation of enough rain from the clouds continues, the people will do well. Then the greed for arable land will, as in India, encroach on the forest minimum, and scarcity, due to the "temporary inconvenience" of a diminished rainfall, will set people wondering why the rain no longer falls in due season. But the denudation, which is the cause of tropical drought will, if permitted to go on, be followed in orderly sequence by the repulsion of the rain clouds. Then the phenomena of alternate drought and flood will take the place of seasonable moisture, and our successors in Africa will find themselves at the same pass as we find ourselves in India, with famine sweeping off a redundant population at one time, and with a deficiency of labour at others.

Famines in India are by some attributed to bad government—to the "tribute," so called, of the home charges unjustly wrung from the Indian Exchequer—to improvident marriages, to a restricted currency, and such economic causes. But it is obvious that these and similar factors cannot be said to cause famine. They only intensify its evils. The one sole cause of famine is the want of rain. If the monsoon falls in due season, the crops are sure and food is locally procurable. But if the rains fail, or, falling, rushes off in great floods, leaving the land dry, a prey to the sun's rays, then drought kills the crops, and produces famine. This can be mitigated by the importation of food; but the only cure is the re-establishment of the periodical rainfall. And this is only possible by the conservation of forest.

The best thing that could happen for us in Egypt now, would be the discovery of a productive coalfield, within easy reach of the Nile. The use of coal as fuel for railways, river steamers, machinery, and for domestic purposes, would give us a respite. It would stay the suicidal destruction of the tree life, which is drying up the sources of the Nile. If the Egyptian Administration could establish a fresh department on an adequate scale, and afforest the waste places left by the Mahdi, both along the Nile and along its affluents, it would be laying the foundations of physical well-being deeply and soundly. But if the lesson is not learnt, if the waste of timber, which is the unfortunate condition of too much of the earth's surface, is allowed to go on unchecked, then our successors will find themselves with beggared provinces on their hands, and the Pax Britannica will brood over depopulated deserts. The French, like the Germans, have a scientific appreciation of the facts, and we may hope, when French Africa has settled down, that a process of reclamation by scientific forestry will be applied to the Sahara itself. The task is not impossible. Then rivers, long lost to sight, would rise to the surface, and bring fertility to what now appears to be hopeless desert. It would be a reflection on our methods if we permitted Egypt to be gradually converted into desert, while the French restored the Sahara to productiveness.—*Birmingham Daily Post.*

Osier or Willow Culture for India and Ceylon.

The cultivation of Osiers, *i.e.*, species and varieties of willow which are specially adapted for basket making, should prove successful, if not a profitable industry, in the hill districts of India and Ceylon. Considering the importance of this industry in Europe, more especially in France and Germany, where it gives employment to many thousands of persons, it is not surprising to hear of fresh interest being manifested in its development in America and Australia. The U. S. Department of Agriculture, Division of Forestry, has lately issued a pamphlet on the subject, dealing with the cultivation and use of Osiers, together with notes on their geographical distribution and characteristics.

Willow-ware should win popularity in India, where the best of timbers are affected by the climate, becoming expanded in wet, and contracted in dry weather. Considering also the universal habit of the natives in carrying everything on their heads which, with even field and factory labourers, is practically the only mode of transport, and the immense number of baskets which must consequently be used in the various agricultural and other industries, light willow baskets, should, in certain districts, find a ready demand. Though bamboo or rattan-wares, perhaps, answer the purpose equally well, these are not everywhere easily procurable, and in some localities their cost is probably more than what the willow article could be supplied for. Besides transport baskets, tea baskets, manure baskets, etc., the flexible willow shoots are fitted for a great variety of useful and ornamental articles of wicker work, the making of which should prove a favourable and remunerative occupation for many natives.

Willow cultivation involves but little care or expense. A marshy soil by the side of streams or rivers or round lagoons, such as is unfit for other agricultural pursuits, is the most suitable. No manuring is required, and a renewal of plants is seldom necessary. Propagation is usually effected by cuttings, which should be about 15 inches long, and planted in lines 2 feet apart. A crop may be expected in the second or third year. Planted on sloping, swampy land, willows should also save the purpose of binding the soil and preventing it being washed away in heavy rains.

Among the best willows for basket-making are *Salix amygdalina, S. viminalis, S. purpurea, S. lucida* and *S. Caprea.*—*Indian Gardening.*

Conifers as Rain Gauges.

According to a recent number of the *Revue Hoerticol*, M. Felix Sahut has lately communicated to the Congress des Sociétés Savantes observations respecting certain plants that act as registering rain gauges. "Mention has already been made of the influence of certain more or less severe droughts in the French

Mediterranean upon Pinus Laricio of Corsica, and Cephalonian Fir. The lengthening of the branches of these two species is always proportionate to the quantity of rain falling during those months of the year when it is most profitable to them. Co-efficients have been established indicating what the degree is for each month of the year. The co-efficients enable the relationship that exists between the amount of rain fallen, and the greater or less intensity of the vegetation which it has encouraged to be determined. It is shown that, under these conditions, it is possible to judge approximately the quantity of rain which has fallen by measuring exactly the length of the leader, or of the branch produced yearly on these species of pine, and if the estimate is not absolutely proportionate to the quantity of rain registered by the raingauge, it closely approaches to it; and a still closer estimation may be made by taking into account the relative value of the results produced by rain in the several months of the year. It is, therefore, possible, to a certain extent, to use plants specially selected for this purpose as actual registering rain gauges."—*Revue Horticole.*

Forests and Famine in Bombay.

I.

Results of the experiment of bringing cattle from Guzerath to graze in the open and closed forests of the Thana district during the famine of 1899-1900.

BY G. M. RYAN, *I.F.S.*

In all about 16,208 cattle were imported into the Thana district from Guzerath, 15,208 head having been brought mainly by private subscription or with the aid of Government advances under Government supervision, and the remainder entirely by private owners at their own expense.

A certain number of cattle also came to graze in the eastern portion of the district from the Nasik and Poona districts; but about these particulars are not given here.

Fifteen thousand head came to Palghar and Dahanu stations, and were drafted thence to forest areas in the Dahanu, Wada, and Bhiwndy talukas of the Thana district, mainly in the Central Thana Forest Division; of these, 11,000 went to Palghar, and 4,000 to Dahanu stations; 10,267 arrived at the grazing areas

30 miles from Palghar Station; the rest died on their way owing to their weak condition, or strayed because their attendants had deserted them.

Six thousand six hundred and four of the above were from Broach (146 miles), 2,512 from Ahmedabad (252 miles), 764 from Panch Mahals (261 miles), and 387 from Kaira (230 miles). The Broach cattle were chiefly bullocks, in charge of owners or servants. From other districts came cows and calves, in charge of Rabarees. Some buffaloes also were sent from every district.

The Broach cattle on arrival were in good condition; the others mostly in poor condition. The death-rate was large from the beginning. Up to the week ending 5th November 1899, 117 died; by the week ending 12th November, 165; by 24th November, when all the 10,267 had arrived at the grazing areas, there were 379 deaths. Many of the deaths resulted from sore feet and from animals eating more than they could digest. At the end of November rinderpest appeared in one area. It was contracted from the village cattle. Disease was not imported from Guzerath. In spite of all efforts, such as segregation, &c., the disease continued up to the end of March, by which time 3,900 cattle had died. The disease appeared or increased in one area as it decreased or disappeared in another. Foot and mouth disease was also rife, and was aggravated by the hilly nature of the ground to which the cattle were unaccustomed.

Unaffected cattle kept fit till the beginning of the hot weather, the Broach cattle remaining best of all. After the hot weather set in, though disease had disappeared, mortality continued; the Broach cattle lost their condition and appeared very poor.

The Panch Mahals cattle fared best through the hot weather.

The mortality averaged about 200 a week steadily, though rinderpest disappeared by the end of March. Finally, 1,202 head were sent back by rail: 541 to Ahmedabad, 323 to Broach, 20 to Kaira, and 296 to the Panch Mahals. But 3,964 had already been returned to the owners who came for them. These were mostly Broach cattle. Therefore, of the 10,267 head, 5,166 were returned. A good many of the returned cattle probably died on their return as they left in bad condition. Of the 4,000 head sent to Dahanu, 1,500 were finally returned.

Water and grazing were sufficient everywhere for the animals in the Thana district. Of 1,000 head which came from the Ahmedabad district to graze in Thana independently of Government aid, not one animal is said to have returned.

I am indebted to Mr. Monteath, *I.C.S.*, for the above particulars. He was actually in charge of the cattle all through the famine, and was placed on special duty for the purpose, having under him Ranger Bhadbhade of Wada, a smart and intelligent Range Forest Officer, who received his training at the Poona College of Science.

The cattle were brought down as the result of a Conference in September 1899 at Palghar, in the Thana district, at which the Commissioner, the Hon'ble Mr. Lely, Mr. Mollison, the Deputy Director of Agriculture, Mr. Metha, *M.R.A.C.*, Mr. Wood, Collector of Thana, Mr. Dodgson, Deputy Conservator, Central Thana, and myself were present.

It was felt at the time that the experiment was risky, but it was thought best to undertake it to settle once and for all the vexed question whether imported cattle would live in Thana. Apparently if foot and mouth disease and rinderpest had not broken out (both these diseases were contracted, according to Mr. Monteath, in the district), the mortality among the animals might not have been so high. The change of air and conditions of soil *and water*, especially the latter, had a great deal probably to do with the high mortality among the animals. Many natives who come down from the Deccan and Guzerath get ill immediately with fever* and often die when they first arrive in the Konkan. Similarly it is thought animals must suffer.† Many, however, believe that the inferior fodder was the important factor in increasing the mortality. They say it was palpable from the beginning that Guzerath cattle would not thrive in Thana for the same reason that Yorkshire sheep do not thrive when taken south to graze, and so on. But Thana grass has for a long time had an evil reputation, and Commissariat Officers in 1897, during the famine of that year, at first declined to accept it for their Government animals, because it was alleged to be unfit for fodder. Necessity, however, made them consent to its use, and since then the previously evil reputation of the grass has been considerably modified. It is now and has been for many years very largely exported to Bombay by merchants, and many of the forests are commencing to be robbed in consequence of this demand. A large quantity, both green and dry, was sent to Guzerath in 1899-1900, and kept cattle alive in the cattle camps that were established there as well as in villages, and further large quantities were sent to the Deccan both for Government horses and cattle and for private animals.

* Abdul Rasool, a very fine man physically, and an excellent Ranger when I knew him (he is now Extra-Assistant), when he came down from the unhealthy part of the Khandeish district to assist in the famine-fodder operations in the western part of the Thana district, was rendered *hors de combat* almost immediately after his arrival with fever and had to be sent back to the Deccan. He soon recovered and rendered Mr. Pearson, the Divisional Forest Officer, West Khandeish, great help in the grass operations which had ultimately to be started there.

† In seasons of deficient rainfall, in the Deccan, cattle from Poona and Nasik are imported by private owners into the eastern hilly parts of the district to graze in the forest; but these are not known to suffer, inasmuch as the climatic change is not marked. The eastern portions of the district, moreover, during the greater part of the year are known to be healthier than the western and central parts of Thana. Annually many hundreds of bullocks are imported by Wanzaras now into the eastern talukas to supply the demand for the carriage of firewood and charcoal from some of the coupes, and I have repeatedly observed that these animals keep in excellent condition on Thana fodder.

In spite of all efforts to save the Guzerath cattle, however, which are a very fine breed of animals, generally about 70 per cent. of them are alleged to have succumbed during the famine. The cattle camps are said to have been a success, and would have been augmented but for the want of sufficient fodder. What to do during the next famine if one unfortunately occurs is, therefore, a problem which the Famine Commission is endeavouring to solve. Some authorities suggest storing grass in the Thana district in *hermetically sealed* sheds to meet a future calamity, and they have, it is believed, seriously recommended this measure. The only practical remedy apparently is to import three or four times the quantity of grass into the famine-stricken areas, and this can be done by increasing the price within which grass is to be landed in the famine area. During the famine the Bombay Government sanctioned a charge of Rs.13 per 1,000lbs. all round as the cost of grass delivered at railway stations in the famine area. Mr. Wroughton, who organized all the arrangements, thinks that the actual cost will probably work out to something less than this.

In a future famine, therefore, the Departmental operations could be considerably extended by increasing the sanctioned rate of supply, say, to Rs.15 or Rs.20 per 1,000lbs., and by utilizing in addition some of the Cotton Presses in Bombay to press grass. The latter was done during the Egyptian war of 1885, when I superintended the pressing of about 4,500 tons of grass in the various presses there, and the work of pressing into bales was both swiftly and excellently performed without much supervision.

The Thana District Forests, both open and closed, could supply, it is estimated, about three or four times the quantity of grass *for export* * that was obtained from them during 1889-1900, and probably other districts could double their quantities, which means that instead of losing 70 per cent., the lives of that number of animals would probably be saved. Departmental operations could be conducted in the interior parts of the district by means of hand-presses, leaving the areas near the railway line for feeding the stream-presses in Bombay with loose grass. The latter arrangement would be expensive no doubt, but if the lives of animals are to be saved, the extra cost must be borne. This and well irrigation in Guzerath are the only means, it is thought, through which the larger proportion of the agricultural stock of Guzerath and the Deccan can be kept alive during a future famine. Perhaps other Forest Officers in the Bombay Presidency

* The total quantity of grass exported for famine purposes from Thana in 1899-1900 was 10,333 tons; a large quantity (5,320 tons) was sent to Guzerath, *also from the Khandeish (Deccan)* district, and a further large quantity was imported into Guzerath and the Deccan from the Central Provinces. What the latter quantity is I do do not know. The Southern Forest Circle, Bombay, supplied about 2,666 tons. The total exports from the Bombay Forests to the famine areas was therefore about 18,319 tons.

or such experienced men as Messrs. Bagshaw and Fernandez, outside the presidency, might offer their opinions on a subject which is of paramount importance for Guzerath especially. In connection with the scheme of export of fodder on a large scale, a number of metalled feeder-roads with tramways might be laid down in Thana for tapping the interior parts of the district. A regular working-plan would have to be adopted for the construction of such roads, the total length to be completed, say, in thirty or forty years. These roads would benefit the Thana district immensely, enhance the value of the material in the existing coupes, and, in addition, a large forest area (Mokhada) would be tapped, which has always been and may always probably remain otherwise unexploited, because of its inaccessibility. This scheme, if considered only from a famine or forest point of view, may seem Utopian, and because of its cost practically impossible of completion, but when considered *in conjunction* with more immediate forest interests as explained above is well worthy the attention of the Hon'ble Mr. Nicholson, who, as a member of the Famine Commission, has taken such a deep interest in the cattle question. Internal communication in the Thana district, away from a few of the main metalled roads, is in a lamentably unsatisfactory state. It takes three or four days for carts laden with forest materials to travel 12 miles, in most instances along some of the important highways, and when hundreds of carts laden some with charcoal and others with firewood and timber, have to travel along these thoroughfares now one can imagine how dilatory would be the progress of any future famine-fodder operations if conducted on a large scale in the interior of the district. A system of well laid out roads, with tramways to be added later, must, therefore, it is thought, run *pari passu* with any large scheme for saving the lives of cattle in Guzerath and the Deccan in a future famine. In 1899-1900, all or nearly all the grass exported from Thana to Guzerath and the Deccan was brought by head-loads to the grass depôts at railway stations to be baled. As Thana is such a vast fodder-bearing tract, and as the rainfall, even if deficient, is not likely to affect its grass-supply (as was proved in the past famine year), *permanent plans* for carrying out extensive famine-fodder operations might safely be laid down for the future as suggested. I was questioned by the Famine Commission about this matter, which is my excuse for taking it up.

II.

Notes on the use of the Seed of the Bamboo (Dendrocalamus strictus) as Flour.

BY W. A. WALLINGER, *Bo. F. S.*

It would not appear to be very generally known that the seed of the bamboo is not *only fit for consumption by man, but*

that, in this corner of India, it is being collected and so consumed to an extent sufficient to ameliorate a very pronounced local scarcity. The *Dictionary of Economic Products, Vol. I.*, contains interesting information on the topic, and the fact that the seed is edible is also referred to in *Agricultural Ledger, No. 17 of 1900.* But the following remarks may, nevertheless, be of some general interest :—

Territorial extent of the seeding.

How far outside the Dharwar district the seeding is taking place I am unable to say. It undoubtedly extends some distance into Kanara. Here two talukas are alone involved. In them it is rarely possible to meet with a single culm not undergoing the process. The approximate area may be stated at 75,000 acres, extending 50 miles from north to south, along belts 3 to 8 miles broad.

Effect of the seeding on the population.

It is generally admitted in this area that but for this prolific seeding, owing to the great scantiness of the rainfall during the past two seasons, the poorer classes would have been hard-pressed. The fact that there has been an unprecedented deficiency in the rainfall over a tract of country which is almost invariably well favoured in this respect, leading in its turn to a sudden seeding of the bamboo, is significant and of interest; but with this aspect of the question I am not at present concerned, except in so far as to incidentally draw attention to the old Brahmin saying: "When the bamboo produces sustenance we must look to Heaven for food." The purely local inhabitants are not the only ones who are taking advantage of the present situation. The news has spread far and wide into territories where forests do not exist, and the influx of people represents a serious factor in the preservation of the reserves from fire. It is a common thing to see cart-loads of bamboo grain plying along our roads where but a short while back grain in any form was at a premium. As it seemed doubtful whether any attempt to place a check on this wholesale removal would succeed on the one hand, or be desirable on the other, no action is being taken to arrest it.

Method of collection.

When the seed is ripe, a very slight shaking of the already dry stems is sufficient to induce it to fall plentifully. The ground is either cleared by firing, if the likelihood of being detected is slight; or the seed is collected in cloths spread on the ground to receive it. A very considerable number of the minute pericarps that drop, however, contain no grain; and I have noticed men and women removing these in the reserves by the well-known process of holding baskets over their heads and then pouring the grain slowly on to the ground and allowing the breeze to do the rest. Some bamboo clumps are abandoned altogether as affording insufficient seed for the labour involved.

Subsequent process.

The collected seed on being brought home is pounded in order to remove the husks. The accompanying *specimens may be of value for educational* purposes at the Forest School. The original seed is marked No. 1. No. 2 is the husk removed after beating; and No. 3 the seed after this primary process. No. 3 is slightly damped and roughly ground, resulting in the sample No. 4 and the bran No. 5. Finally the coarsely-ground seed (No. 4) is re-ground and results in the cooking flour No. 6.

Cooking.

This flour is either mixed with rice or "jowari," or eaten by itself, prepared into the ordinary flat cakes of the country, termed "chapatis." It is said by the natives to be sufficiently nutritious; and the mere fact that it is so largely collected shows it so to be. Nevertheless it would be of interest to ascertain what percentage of proteids *the flour contains, and where it would stand in the scale as a* nourishing form of diet.

General.

It has been found that two women can collect about 8lbs. of the seed in the day, which, after the removal of the husk and bran, is reduced to 6lbs. This quantity will make 30 cakes 7″ in diameter, or sufficient, it is said, to feed an able-bodied man for six days.

It is interesting to note that the flour is being bartered in local markets by the poor for "chillies" and other condiments; but there is, so far, no recognized market rate.

My horse, bullocks, goats and sheep refuse to touch the bran referred to, even when mixed with their ordinary grain. The seed is eaten raw under protest, but when cooked is more appreciated.

Swamp Forests in Dehra Dun, N.-W. P.

By Upendranath Kanjilal, Assam Forest Service.

In the district of Dehra Dun there are three detached bits of swamp forest possessing great botanical interest.

The most important of these is the one near Mothronwala within three miles of Dehra Dun, which is the chief town of the district, and stands at an elevation of about 1,900 feet. There appears to be a clay-bed cropping up here, which extends northward all the way to the foot of the Himalayas, underlying the immense mass of gravel deposit that forms the northern flank of Dun valley. The tropical rainfall of nearly a hundred inches in the year, which infiltrates through the gravel extending over perhaps 40 square miles, oozes out here in a series of deep but narrow ravines, giving rise to a number of streams, which uniting into a few main channels pour into the Suswa, a river which is all but dry above the swamp. Where two or more of such streams meet, the bed widens to some extent, and the increased sluggishness of the current causes a deposit of earthy matter to be formed

which has given rise to low islands only a few inches above the level of the water even during the driest season.

In their upper portions the ravines are deep and narrow, alternating with equally narrow spurs cut out of the original gravel deposits. On the tops of these spurs and even some distance down their sides, there is sál with almost all its usual companions. Consequently, to one stationed but a few yards from the edge of the forest on the flat fields or grass-lands that surround it, it has all the appearance of a typical sál forest. But as one draws nearer one sees through the straight trunks of the sál the deep-green foliage of the Ban oak (*Quercus incana*), this tree finding in the cold clayey soil and moist damp shade of the narrow ravines factors of locality somewhat similar to those prevailing in its proper habitat, which is a zone between 3,000 and 8,000 feet in the hills. As if to keep company with the oak, two climbers characteristic of the above zone, viz., the ivy (*Hedera Helix*) and *Ficus scandens* also occur, very often clothing its grey trunks with their evergreen verdure. Lower down in the ravines are found quite a number of most interesting species which only occur in marshy localities or at higher elevations, the chief among these being *Cocculus laurifolius*, *Acronychia laurifolia*, *Olea glandulifera*, *Cyclostemon assamicus*, *Phœbe lanceolata*, *Machilus odoratissima*, *Machilus Gamblei*, *Litsæa lanuginosa*, *Celtis australis*, *Toddalia aculeata* and *Glycosmis pentaphylla*; while in the beds and along the edges of the streams, as also in the low islands, prevail *Bischofia javanica*, *Cudrania javanensis*, *Salix tetrasperma*, *Acer oblongum*, *Glochidion lanceolarium*, *Ficus glaberrima*, *Citrus medica*, *Elæagnus latifolia*, *Trachelospermum fragrans*, *Callicarpa macrophylla*, etc., interrupted only by canebrakes of *Calamus tenuis* where the current is perceptible, or by banks of *Typha elephantina* and *Typha Laxmanni* where the water is stagnant. The water-edge is lined with various kinds of weed, chief among them being Ferns, Sedges and Typhas.

The next swamp worthy of note is between the Dehra-Hardwar Road and the Song river, at Nakraunda, where it gives rise to a large tributary of that river. This seems to owe its origin mainly to obstruction of drainage by the Nagsidh hill, but possibly there is also an outcrop of clay-bed similar to the one at Mothronwala. With the exception of *Machilus odoratissima*, *Litsæa lanuginosa*, *Olea glandulifera*, *Acronychia laurifolia*, and *Quercus incana*, all the other species mentioned above as occurring in Mothronwala are also found here. But as a set-off the following are seen which are unknown in that swamp, viz., *Carallia integerrima*, *Marlea begoniæfolia*, *Berchemia floribunda* and *Trema orientalis*.

The last noteworthy swamp or group of swamps is that near Khairi, at an elevation of about 1,200 feet. In respect of grandeur of forest, growth this excels by far the other two swampy areas. On the outskirts is a dense lofty evergreen belt composed of

Diospyros Embryopteris, *Putranjiva Roxburghii*, *Holoptelea integrifolia*, *Ficus bengalensis*, *Ficus glomerata*, etc., with as dense an undergrowth of *Murraya exotica*, *Murraya Kœnigii*, *Adhatoda vasica* and *Glycosmis pentaphylla* ; while inside the swamps, which are open and sunny, is the usual canebrake in which, however, wild plantain, *Pterospermum acerifolium*, *Bauhinia Vahlii*, and occasionally sál and *Alstonia scholaris* are inextricably mixed.

Rotation and Possibility in Selection Forests. *

BY F. GLEADOW, *I.F.S., F.R.M.S.*

With reference to my article on the above subject in the March Number of the *Indian Forester*, Dr. Schlich has written to the *Revue des Eaux et Forêts* a paper which may be translated as follows:—

"Under the title '*Une catachrése forestiére,*' M. Broilliard has published an article in the *Revue des Eaux et Forêts* for October 1900. In this article, M. Broilliard once again recommends the possibility by area in Selection forests, and attempts to show the inutility, or worse, of using the term *rotation*. On the first point I am entirely in accord with M. Broilliard. My experience of more than forty years has shown me that whenever the possibility is fixed by volume, the result has been either that—

"(1) Conscientious and prudent Forest Officers always undervalue the yield for fear of exceeding it, or

"(2) Those who are not too conscientious habitually exceed it.

"In both cases the result is loss. Hence the sole way of assuring a durable working-plan for Selection forests is to adopt a possibility by area.

"On the second point M. Broilliard appears to go too far. Without doubt the different annual fellings differ more or less in outturn, but in every case the object should be to reduce them all to the normal condition, so as to assure, as far as possible, a sustained yield.

"Thus the fellings in open crops must be made with a light hand, and with a heavy one when the crop is heavy. But this is not all. Supposing that we have to deal with a forest which yields perfectly regular annual fellings, the question will nevertheless always arise, "How much to cut?"

"In the first place, the laws of sylviculture must decide, and they prescribe:

"(1) The cutting of all mature trees that do not show a satisfactory rate of growth.

"(2) The cutting of all sickly or deformed trees that can be spared from the crop.

"(3) The cutting of all young trees whose room is culturally preferable to their company.

* Vide *Indian Forester*, Vol. XXVII., No. 3, March 1901, page 121.

"Now it may happen that a *felling made* in accordance with these prescriptions would be so severe that there would be nothing fit to remove *on the next* return of the fellings after *a certain* number of years. M. Broilliard himself, in his allusion to the forest of Pont-à-Mousson, has shown *how undesirable* this is. In order to avoid the prospect of such inconvenience, it is necessary to lay down a *rule that* no more than a fixed proportion *may be* cut at once. Take, for example, a coppice-with-standards: '*fell one standard out of four*,' what *does it mean?* Supposing the coppice is cut at thirty years old, the four standards will be all cut in $4 \times 30 = 120$ *years*, and four new oaks will have *replaced them*. Here we have *actually* a rotation of 120 years, or if we *include* the age of the coppice, 150 years. This little calculation always passes through the brain of the Forest Officer, whether he is definitely conscious of it or not.

"In cutting one standard out of *four* he is fixing the rotation; that is to say, the number of years allotted for one crop to be replaced by the next. It is the same thing in selection. On the average, the crop is replaced by a new crop after a certain number of years, which is the rotation. The length thereof is determined by the quantity cut at each felling. Why then this aversion to the term rotation? It seems to me so harmless.

"In France, foresters have declared war against the application of mathematics to Working Plans. After all, what is the working-plan but an exact and systematic application of sylviculture? No treatment can be correct if it is not based on this fundamental principle. At the same time a working-plan, if it has any regard for a sustained yield, cannot possibly attain its objects without the application of the elementary rules of mathematics. When foresters distrust mathematics in working-plans, the fault can only lie in the application, and not in the principles. Mathematics *must* be the handmaid, rather than the mistress, of sylviculture."

When such doctors differ who shall decide? Truly it is possible with Dr. Schlich to deduce, on *the average*, a rotation, but it is a *rotation* on paper. It *must* also be conceded to M. Broilliard that for any given standard or tree of the crop the actual age of felling will in many or most cases not coincide with the paper rotation.

Deodar Insect Pest in Bashahr, Punjab.

By G. G. Minniken, *I.F.S.*

This subject having attracted some attention in recent numbers of the *Indian Forester*,* it may be of interest to add a few more notes to the information that has already appeared. The insect is approximately identified as a Scolytus, a beetle

* Vide *Indian Forester*, Vol. XXVI., No. 12, and Vol. XXVII., Nos. 2 and 3.

well known to Foresters. Louis Figuer in his book on insects says that in 1837 they were obliged to cut down in the Bois de Vincennes twenty thousand feet of oak trees, aged from thirty to forty years, completely ruined by the ravages of the Scolytus. Its occurrence in Bashahr was first noticed by myself last August in one of the forests of the semi arid tract of Kanowar, which has an annual rainfall of 22 inches. The forest occupies a N.-N. W. to N.-N. E. slope at an altitude from 7,500 to 8,000 feet, and its soil is very rich, the rock being a gneissoid granite. Its growing stock consists of thirty to thirty-five years old poles, for the most part deodar, and contained, until thinned out in 1888, a large admixture of Pinus excelsa. At the present time the poles are vigorous, and there are no sickly trees to be found among them; but the decayed stumps of the thinning operation remain, and suggested the idea that the Scolyti might have bred in them. The beetle collected turned out, however, to be quite different. C. F. M. in the December Number of the *Indian Forester* describes the beetle observed by him in decaying trees as belonging to the genus Cerambyx; but it has no connection with the deodar pest, and as far as I know only frequents rotten timber. Mr. Stebbing, from a specimen sent him, thinks it belongs to the tribe of Longicornes (*Cerambycidæ*). But an enquiry regarding all points likely to throw light on the outbreak is still proceeding, and as it may be possible, later on, to determine with accuracy some of the factors mainly responsible, it would at this stage be mere speculation to attempt a solution. It is, however, probable that the partial failure of the rains in 1898 and the abnormal light snowfall of the following winters in the infested localities have had much to do with its development. No traces of the pest has been found west of Wangtu, in Lower Bashahr, where the annual rainfall is 60 inches; nor on mature trees; so the natural inference is that the insect does not flourish in moist and damp localities, that it prefers pole forest on dry sunny slopes, and that heavy rain and snow might lessen its attacks or effectually eradicate it. But it was considered unsafe to rely upon the disposition of rainfall and snow for effecting a cure; so preventive measures were taken at once. The infected poles were felled, and those not given to villagers or extracted departmentally were burnt outside the forest. The bark was peeled off the stumps and also burnt, and with a view to prevent dispersion of the larvæ and beetles, trenches were dug round the patches from which diseased trees had been removed, but whether this was of any practical use is unknown, as no insects or larvæ were found in them. Watchers were posted to report fresh cases, but though prior to the felling of the poles the attacks had continued to extend to individual poles here and there in about an acre of forest, no more were touched after the preventive measures were completed. The scraping off of the bark was tried, and as the insects live and breed in it, their destruction is inevitable if the work be done thoroughly

and the bark burnt afterwards: but its application is only practicable when the tree can be saved. Associated with the larvæ of the Scolytus I found in large numbers a pink coloured larva, much larger than the scolyti larvæ, which the Inspector-General thought was a parasite, and this has since been confirmed by Mr. Stebbing, who informs me that it belongs to the family of beetles called Cleridæ and probaby feeds on the scolyti larvæ and eggs. If this turns out on further observation to be correct, it will be an important discovery, and may account for the pest not spreading with its usual rapidity, and to its depredations being restricted at present to small areas and groups.

It is by no means certain that the ravages of the Scolyti have ceased, and if they should reappear in the spring and with the Cleridæ, it would be an interesting experiment to breed some of the latter as enemies of the pest. The Pinus excelsa is also attacked by a beetle regarding which I hope later to send a note.

Borggreve's Formula.

BY GNUSHWE.

Borggreve's Formula for the increment per cent. of single trees and of whole woods, and its practical application by means of Pressler's borer.

I—DEVELOPMENT OF THE FORMULA.

i. Single trees.

Let b = breadth of last annual ring in inches.

,, c = circumference at breast height in inches.

,, d = diameter of section ,, ,, ,,

Then last year's increment per surface of section

$= c \times b$

$= a\,\pi \times b$

$= a\,\pi \times \frac{1}{n}$, where n represents number of rings per inch diameter measured from periphery of stem.

$= \frac{d\,\pi}{n}$.

Hence, if h = Increment % (volume).

$$p : 100 :: \frac{d\,\pi}{n} : \frac{d^2\,\pi}{4}\ *$$

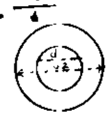
$$\therefore p = \frac{400}{dnc}.$$

* The yearly surface of section increment *is proportional to* the yearly volume increment. Proof as follows, (f = form factor) :—

$$\frac{d_1^2\,\pi}{4} \times h_1 \times f_1 : \frac{d_2^2\,\pi}{} \times h_2\ f_2 :: d_1^2 : d_2^2$$

For 1 year's growth $h_1\ f_1$ may be taken $= h_2\ f_2$ (= hf).

$$\text{Hence} \left[\frac{d_1^2\,\pi}{4}\ hf - \frac{d^2\,\pi}{4}\ hf \right] : \frac{d_1^2\,\pi}{4}\ hf - :: \left(d^2\ d_2^2 \right) : d$$



i.e.,—Diameter or surface of section increment is proportional to volume increment.

ii.—For a number of trees.

Let $d_1\ d_2\ d_3$ .... be the diameters of the several trees.

" $n_1\ n_2\ n_3$ .... as before (for the several trees).

Since, Increment % for single tree $= \frac{400}{dn}$

$\therefore$ Actual Increment per single tree $= \frac{d^2\pi}{4 \times 100} \times \frac{400}{dn}$

For, $p : 100 :: I : V$

$\therefore I = \frac{V}{100} \times p$

and V is proportional to sectional area.

Hence,

$$p : 100 :: \Big[\overbrace{\frac{d_1^2\pi}{4 \times 100} \times \frac{400}{d_1 n_1} \times \frac{d_2^2\pi}{4 \times 100} \times \frac{400}{d_2 n_2} \times \ldots\ldots}^{=\,I,\ \text{the increment.}} \Big]$$

$$: \Big[\overbrace{\frac{d_1^2\pi}{4} \times \frac{d_2^2\pi}{4} \times \ldots\ldots}^{=\,V,\ \text{the volume.}} \Big]$$

$$\therefore p = \frac{100 \left[\frac{4}{n_1} d_1 \times \frac{4}{n_2} d_2 \times \frac{4}{n_3} d_4 \times \ldots\ldots\ldots\right]}{d_1^2 \times d_2^2 \times d_3^2 \times \ldots\ldots\ldots}$$

Or, written shortly—

$$p = \frac{100}{\ } \frac{\Sigma \frac{4}{n} d}{\Sigma\, d^2}$$ = Borggreve's Formula for the Increment % of a whole wood, n being as above.

II.—Application of the Formula.

For a whole wood.

A number of trees representing averages of the whole are selected, and the diameters measured (in inches) and recorded. Cylinders of wood are also extracted by Pressler's borer, and the number of rings are *counted* in one inch of diameter, measured from the outside, not including bark. It is most convenient to keep the cylinders and count the rings subsequently, recording the *corresponding* diameter.

The calculation is then made as follows, the first two columns representing the data :—

Diameter of stem d (cm.)	No. of rings per cm. diameter., n.	d^2	$\frac{4d}{n}$
41	13	1,681	12·62
24	18	576	5·33
30	8	900	15·00
		3,157	32·95

Then Increment % $= \frac{32 \cdot 95 \times 100}{3,157} = 1 \cdot 04$.

In practice, a fairly large number of measurements are necessary in order to ensure greater accuracy.

The Forests of Arrakan, Burma.*

BY E. P. STEBBING, *I.F.S.*, *F.E.S.*

Dr. Schlich's report established in 1870 the following facts:—

The reasons against the Reservation of the Arrakan Forests in 1870, compared with those that have since cropped up in favour of a reconsideration of this decision.

1st.—That the quantity of ironwood timber of all sizes in the Arrakan forests was very great.

2nd.—That the present rate of consumption was very low indeed when compared with the yield he estimated the forests could produce.

3rd.—That the character of the timber generally was against any large trade being done in it. Beyond local purposes there was no demand for it, and what export trade there was, had entirely died out.

4th.—That there was no demand for other classes of timber.

In the face of these facts the Local Government, in their resolution on the report, held that no case had been made out for the reservation of the Arrakan forests. I have already promised to show how since this conclusion was arrived at conditions have materially changed, and that what was doubtless a correct decision in 1870, is perhaps not applicable to the altered state of affairs in 1900.

In a letter No. 200F., dated 14th March 1871, from the Government of India, Public Works Department, to the Chief Commissioner of British Burma, the Governor-General's conclusions for not conserving these forests are given, and in it the management to be instituted is decided upon. I will take these conclusions separately and endeavour to show how time and progress have, to some extent, subverted them.

1. The cutting and export of Pyinkado.

The Government of India commence by saying that it does not appear from Dr. Schlich's report that there is any certain prospect of increase in the present rate of local consumption of ironwood, although there is plenty of it, nor was it probable that the export trade, which had entirely died out, would revive. The character of the timber, no doubt, militated against its real usefulness, it being hard to work, and it apparently did not find favour with Railway Companies for sleepers. The question now before us is, therefore, how far are these reasons applicable to the altered conditions of the present day? The wood is still as hard as it was in the days of yore, and it is probably still as abundant, but conditions have changed. The Assam-Bengal Railway has appeared on the scene, and this Railway's track is chiefly laid with Pegu Pyinkado sleepers brought from Rangoon. These sleepers are landed at Chittagong at

* Begun in February Number, 1901.

Rs.2-4-6 per sleeper, this rate including the expenditure incurred on unloading, turning for passing and stacking. The Railway at present requires about 12,000 sleepers per annum, and will take a good many thousand in the years to come. My reason for stating that this number will be large is that the line, which is still under construction, or portions of it, is only now being metalled and the sleepers put down about nine years ago or so, having spent that time lying in a mud bed instead of in a metalled track, are already showing signs of wear and deterioration, and will require replacing. It should be possible to provide this supply from the Pyinkado forests of Arrakan, and this alone would, I think, justify a re-inspection of these forests and a reconsideration of the judgment passed on them in 1879. I have already stated that such an import has commenced, 60 tons of Pyinkado sleepers having been brought in in 1898-99. In addition, beams, posts and planks of Pyinkado are exported, as a reference to Appendix B. will show.

It would appear that the demand for ironwood in the market is on the increase. The following remarks on this timber are extracted from the *Agricultural Ledger* (1899 No. 11):—

In Burma and Bengal Pyinkado has been largely employed for making railway sleepers and telegraph posts. Between 1865 and 1868 inclusive, 70,377 sleepers were obtained by the East Indian Railway Company from Arrakan. The Burma State Railway was laid with sleepers of this wood in 1877, the majority of the sleepers were still good in 1894. In 1876-77 Major Seaton reported that 10,000 sleepers from Arrakan sold in Calcutta at Rs.5 each, while in 1884-85, 17,631 were sold there at Rs.2-1-0 each (compare with Rs.2-4-6 paid by the Assam-Bengal Railway at Chittagong for Pegu sleepers). The cost of cutting and freight was said to have amounted to 12 annas per sleeper. (In addition, we have the 60 tons of sleepers imported into Chittagong in 1899-1900.)

In 1885-86, 81,569 sleepers were removed from Burma by Government Agency, of which 75,000 went to Madras and the remainder to Calcutta. The profit which accrued from the works in the Pegu Circle amounted to 36 per cent. A certain amount of scantling is also turned out of the mills in Pegu for building purposes and railway keys. Trees of 3 to 4 feet girth are used as house-posts and bridge-piles. For these purposes it is said to be unequalled owing to its durability.

It has been found to be a most suitable wood for street paving, and one mill in Pegu is supplying planks 9 feet by 3 inches for paving blocks for England.

With a view to making its qualities in this respect more widely known, under orders from the Inspector-General of Forests some good samples of ready-cut paving blocks of Pegu Pyinkado have been sent this year (1900) to Paris to be exhibited at the Paris Exhibition.

In South Tenasserim and Pyemnama the Burmans make houses and bridge-posts and oil presses from the wood, also harrow teeth and yokes for buffaloes.

During the last few years a new interest has attached to the Pyinkado timber trade in consequence of the refuse of the sleeper works in Burma having been found to be astringent and useful for leather manufacture.

2. The cutting and export of timbers other than Pyinkado.

At the time Dr. Schlich wrote his report no other wood save Pyinkado had any export value, and therefore the subject of these woods was not touched upon by the Government of India in their letter above-quoted. Conditions have changed since then, and at the present time a larger demand has arisen for the wood of the jarool, khoira, garjan and, to a lesser extent, of other trees. I have already shown that boats (dugouts), beams, planks, scantlings, &c., of these woods are exported to Chittagong, Barisal, Chandpur, Naraingunj, and other places in Eastern Bengal.

3. The amended rules of 1865 and the method of working them as regards Toungya cultivation and conflagrations.

The amendments to the rules of 1865, as proposed by Dr. Schlich, were agreed to by the Government of India, and especially so with reference to the Toungya cultivation and to conflagrations. North of the Kolandyne the enforcements of these rules cannot apparently be carried out, this fact being evidenced by the numerous clearings and areas covered with a small scrub jungle (both the result of the Toungya cultivation) everywhere apparent, and by the number of fires seen burning over the hills at night. An inspection of the large Pyinkado forests to the south would not improbably show a very similar state of affairs, since without the most careful supervision it is impossible to stop this sort of destruction.

4. The staff to be employed to carry out the amended Rules.

Whilst agreeing that any system of forest conservancy involving a large outlay was not advisable, and that the forests should remain at present under the supervision of the civil authorities, it was agreed by the Government of India in 1870 that a Ranger should be appointed, under the control of the Deputy Commissioner, for the southern forests to see that the rules were put into force and obeyed. Dr. Schlich had proposed a staff of one senior capable officer with three clerks and fifteen subordinates to help him. It is hardly probable, therefore, that this one man could alone have ever made much headway in forest conservancy, and, if he is still entertained, it is probable that at the present day he is doing more harm than good to the forests under his charge. The export of Pyinkado from these forests, which has apparently restarted, would, at any rate, seem to demand an enquiry. It is doubted whether a Ranger would ever be required for the forests in the north of Arrakan. It is from these very forests,

however, that the cutting of trees other than Pyinkado is now taking place, and bids fair to increase largely and develope into a fair export trade. It however requires careful watching, and it is probable that the forests will easily repay the extra amount expended on the supervision.

Summary of reasons for considering it advisable to reconsider the decision of 1870 against the Reservation of the Arrakan Forests.

From the above arguments, it will be gathered that since the opinions formed on these forests in 1870 were arrived at, a great change has taken place in their position from a commercial point of view. From being isolated and considered useless as reserves, they have now acquired a commercial value, and the extent of this value demands an enquiry.

A Railway has appeared in the vicinity, a Railway whose track is laid principally with Pyinkado sleepers, the sleepers at present in use being imported from the Pegu forests in Burma. It is not improbable that the Pyinkado forests of Arrakan will soon attract the attention of the contractors who are already at work in the north, and they will at once snap at the chance the present arrangements would give them of competing with the Pegu sleeper trade on such, to them, favourable terms. That a start has been made in this direction is proved by the import into Chittagong of 60 tons of Pyinkado sleepers from Akyab. Beams, planks and posts of this wood are also being exported from Akyab. Before this export is allowed to expand any further, an inspection should be made by a competent authority, and if my surmises prove to be correct, it will be necessary to introduce a proper system for the management of the forests, and to exercise a good supervision over all contractors working in them. Dr. Schlich's report shows that there was a large surplus stock of wood in the forests in 1870. During the 30 years that have passed since then, this stock will have increased, and it is probable that a very handsome profit may be obtained from working the forests, whilst at the same time the growing stock in the woods themselves is being improved. Secondly, a brisk demand for jarool, khoira, garjan, and other woods has developed, and the northern forests of Arrakan are now being denuded to supply it. As a result the woods are suffering, whilst at the same time Government is not getting its full royalty on the timber.

Thirdly, the Toungya cultivators appear to have full sway over the forests, with what disastrous results is only too well known to the forester. Fires also appear to sweep unchecked over the forest-clad hills in the hot weather months, leaving ruin in their wake.

Conclusion.

My object in writing this note has been to redirect attention to these Arrakan forests with a view, it is true, to their being worked--but worked in a justifiable and profitable manner. To one and all, I suppose, save, perhaps, to those pecuniarily interested—the destruction of a

fine virgin forest, a forest that has grown up and occupied its present site during untold ages, must appear a melancholy proceeding, and to none more so than to the forester whose business it is not to clear forests off the face of the earth but to carefully tend, beautify and preserve them.

It is hoped that these Arrakan forests will be saved from the fate which would seem only too surely to threaten them, a fate which sooner or later befalls all forests left unprotected to the tender mercies of the lumber man and his methods.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

The Best Season for cutting Bamboos.

In para. 2 of the Proceedings (Forest) No. 255, dated 24th June 1898, of the Madras Revenue Board, the Conservator was requested to arrange for a series of experiments with regard to the effect of cutting bamboos at different seasons.

The Collectors of the marginally noted districts were asked in July 1898, to instruct their District Forest Officers to carry out such experiments and report the results. Their replies are noted below :—

Nilgiris.
North Coimbatore.
South Coimbatore.
South Malabar.

Nilgiris, 30th June 1899.—Bamboos were cut in all the Ranges, except Ootacamund, a few days before and after new moon and full moon, and kept separate from each other. Some were smoked, and others were soaked; with the result that, if cut in dark nights and immediately soaked or smoked, the bamboos are not attacked by the borers. The period the bamboos were smoked or soaked was two months. From the experiments conducted in the different ranges, it is noticed that the bamboos felled during dark nights have not been attacked to such an extent as those felled during bright nights. It has been observed that soaked bamboos fared much better than those that were not soaked, though they were in two cases found attacked, which may probably be due to the fact that immersion was not quite complete. As soon as the bamboos are cut, they should be fully immersed in water for some time, or properly smoked in a shed, as otherwise they are liable to be easily attacked by insects. As soon as the bamboo is cut, the mother beetle lays her eggs in it when the flow of sap in the bamboo is not abundant, and the result is the formation of larvæ, which in their turn become transformed into pupæ; and the young beetle therefrom cuts its way out, with the result that the bamboo is reduced to little more than powder. So the best method is to soak the bamboos as soon as they are cut, which not only prevents the deposition of eggs, but also renders the bamboo unsuitable for the sustenance of the young larvæ. Smoking has also a good influence over the bamboos; but those merely stacked on the ground have suffered considerably, particularly those that were felled during the bright nights.

North Coimbatore, 24th August 1899.—A series of experiments were conducted in Satyamangalam Depôt. During each week of the month one head-load of twenty-five bamboos of two kinds: (1) dry solid bamboos known as *Karanai*, and (2) green hollow bamboos known as *Varai*, were set aside and marked. Dry bamboos appear to withstand the attacks of insects better than the green. In every case the ravages of insects appear to begin with the bamboos on the inside of a bundle, *i.e.*, when not exposed

to the light. The result of the experiment has been that the moon has no effect on the bamboos; and that bamboos exposed to light and air are less liable than those that are not so exposed. Comparative results of the experiments conducted were separately recorded in statements received with the letter.

South Coimbatore, 18th February 1899 and 1st November 1899.—A series of experiments were made on two occasions at Mount Stuart; one from the 2nd August to 1st September 1898, and the other from 10th March to 12th April 1899.

On each occasion ten large bamboos *(Bambusa arundinacea)* and ten small *(Dendrocalamus strictus)* were cut daily. Each bundle of ten was labelled, and the bundles were all laid out in a row. Those cut on the first occasion were examined one by one on 2nd February 1899, with the result that the influence of the moon has not much to do with the presence or absence of the borer.

On the second occasion half the length of each bundle was covered with mats, and the other half was left uncovered. This was done in order to try the effect of shade also; the bamboos were examined in the beginning of October. This has shown that bamboos attacked by borers in the covered portion are about double the number of those attacked by them in the uncovered portion; that is to say, that borers do not attack them so much in the sun as in the shade.

The following is the comparative statement on both occasions:—

	Percentage attacked by borers on the first occasion.	Percentage attacked by borers on the second occasion.
Bambusa	50·53	34·33
Dendrocalamus	39·47	41 66

It will be seen that there is only a slight difference in the Dendrocalamus cut on the second occasion; whereas in Bambusa the percentage is 16·20; showing thereby that bamboos cut in August 1898 were more liable to be attacked by borers than those cut in March and April 1899.

South Malabar, 4th October 1899.—A series of experiments were made from 2nd August 1898 to 7th April 1899, at full moon and new moon days. On each occasion a bundle of twenty-five bamboos was soaked in mud and water and a bundle of twenty-five each was simply stacked. Bundles of ten each were also tried on two occasions similarly. The experiments have shown that neither soaking nor felling at any particular stage of the moon has any marked effect in preserving the bamboos from the attacks of borers.

There appears, however, to be some virtue in the bamboos felled during January, February and March, which are not attacked by borers. Stacked bamboos have invariably been attacked except those felled during this period.

The above is only a shortened form of the district reports, and cannot be called a précis of them. Any attempt to do it will only alter the subject matter. As far as it can be seen, the opinions of the District Forest Officers differ as noted below briefly:—

South Malabar.—Neither soaking nor felling at any particular stage of the moon has any marked effect in preserving the bamboos from the borers; but those cut from January to March are less attacked than those cut at other seasons.

Nilgiris.—Bamboos should be cut two or three days before or two or three days after new moon, and should thoroughly be soaked in water for some time; or properly smoked in a shed. The latter is considered to be the best.

North Coimbatore.—The moon has no effect on the bamboos. Those exposed to light and air are less liable than those not so exposed.

South Coimbatore.—Bamboos left in the sun are liable to less attack of borers than those left in the shade. Bamboos cut in August were more liable to be attacked by borers than those cut in March and April 1899.

[Communicated by Mr. A. B. Jackson, I.F.S., Deputy Conservator of Forests, Madras Presidency.]

Forest Pests.*

I.—Teak Tree Pests.

Arctiid Moth.—In July 1898, through the Director, Imperial Forest School, Dehra Dun, from the Deputy Conservator of Forests, Kurseong Division, were received, in the Indian Museum, specimens of a moth said to be doing considerable damage to teak trees in the Bamonpokri plantation.

The Deputy Conservator of Forests wrote:—

"The caterpillars first appeared in August last, and by October they had completely stripped all the trees of their leaves, and again in January last they destroyed the young leaves."

The insect is an Arctiid moth, but the specimens sent had been so badly rubbed and broken that it is quite impossible to identify the species; they, however, appeared to be a new teak pest, and differed widely from the two known species previously recorded in the pages of these notes.

2. *Hyblæa puera, Cram.*—In June 1898 some moths were forwarded to the Museum by Mr. T. T. Bourdillion, Conservator of Forests, Quilon, as doing immense damage to teak plantations of Southern India.

* Indian Museum Notes, Vol. V., No. 1. Office of the Superintendent of Government Printing, India, 1900. Price one rupee.

The specimens were identified with *Hyblœ puera*, Cram., a common teak pest in India.

The following is an extract taken from a report furnished by the Forest Ranger :—

"The attacks generally begin in April, when the teak tree has put on its new foliage, and they last for about six weeks, when the caterpillars begin to disappear, but one or two may always be found on the teak if a search be made for them. The wet weather probably prevents the moth from increasing, and very little is seen of it until September or October, when, if the north-east monsoon is light, its caterpillar may again attack the teak, the attack lasting about a month. Both very dry and very wet weather seem detrimental to the spread of the insect.

"When the caterpillar begins to pupate, it suspends itself by threads at either end to a leaf, not necessarily a teak leaf, spins a cocoon round itself, and folds the leaf over, so that it is quite snug.

"The caterpillar will eat the leaves of some jungle plants as well as teak, and it has been found in the jungle.

"The caterpillar, when it has once begun feeding, never leaves the tree, though it may shift from branch to branch when its food is exhausted in one place. It does not drop by a thread to the ground when it wishes to change its skin, and, therefore, the system of tarring the stems of the trees employed in Germany to prevent the caterpillars re-ascending them, is inapplicable."

3. *Paliga damastesalis*, Walk.—From Mr. R. S. Hole, Divisional Forest Officer, Damoh, were received in September 1898, specimens of the larva, pupa and imago of the Pyralid moth, *Paliga damastesalis*, Walk., as injurious to teak trees in the forest of Damoh.

The insect has previously been recorded as attacking teak in the Rangoon district, *vide* Indian Museum Notes, Vol. III., No. 2, p. 94.

The following notes have been furnished by Mr. R. S. Hole regarding the pest :—

"Full grown caterpillar is about ¾ inches long, of a greyish to yellowish green colour, dark above and lighter beneath. When young, the caterpillar is a light yellowish green.

"The caterpillars feed on the leaves of teak trees, devouring the leaf parenchyma, but leaving the vascular tissue untouched, and in this district the caterpillar does a great deal of damage, principally during the rains, from June to October. Teak trees on a whole hill-side may frequently be seen which are absolutely defoliated. The caterpillar pupates on the back of the leaves it has been feeding on, the pupa being kept in position in a hollow of the leaf by a weft strung across it. I have watched the caterpillars making this, they swing their heads quickly from right to left and left to right as they attach the thread on each side, and draw it across to the other. The pupa falls to the

ground with the dead leaves, but I do not know where the eggs are laid; I fancy somewhere on the trees, for I have frequently seen very young caterpillars, apparently just out of the egg, feeding on the leaves. I also fancy this insect must have two generations in one year, for frequently the second flush of leaves put out towards the end of the rains is also destroyed by the caterpillars.

"The trees which receive most damage are those on dry stony hill-sides, particularly if the teak there is nearly pure. Trees in moist situations, especially where the growth is luxuriant, seem to be little damaged. Whether this is due to the effect the locality has on the insect and its life history, or to the fact that the trees are better able to repair or withstand the damage, I do not know."

II.—Sâl Tree Pests.

Leucoma diaphana, Moore.—In February 1898, Mr. J. Campbell, Deputy Conservator of Forests, Assam, Golaghat Division, despatched to the Museum two varieties of caterpillars which had been defoliating sâl trees on a very large scale in the forest of Dubri.

The insects were (*a*) some larvæ of a Noctues moth of the species *Leucoma diaphana, Moore*; (*b*) small caterpillars, apparently the larva of a Bombycid moth, but as the specimens were decomposed, nothing could be made of them.

(2) *Bombycid Moths.*—In June 1898, the same officer forwarded specimens of moths defoliating sâl in the forest of Dubri.

These belonged to the following species, but as the specimens were so much rubbed and damaged, the identifications are to a certain extent doubtful: (1) five specimens of a moth *Lymantria grandis*, Walk.; (2) one specimen of *Trabala vishnu*, Lef.; (3) one specimen of a moth *Dasychira*, *sp*.

Casuarina Tree Borer.

In February 1898 the Director, Imperial Forest School, Dehra Dun, forwarded particulars and specimens to the Museum of an insect found boring into casuarina trees in the forest of Nellore.

The worms proved to be the larvæ of a moth, probably one of the Hepialidæ, the specimens being insufficient for further identification.

The following is an extract taken from a report furnished by the District Forest Officer, Nellore:—

"So far as I know, as yet the borer is doing no great damage, especially as the trees are used for fuel and not timber. But in matters of this kind—and the more so in plantations where only one species of tree is grown—it is well to take advice at as early a stage as possible, not only with a view to providing a remedy against the attack itself, but to be on one's guard against other possible complications which may arise from the vigour of the trees being interfered with."

V.—SHIKAR AND TRAVEL.

The Story of a Whistle.

Among Central Indian sportsmen, Kathawari will always rank as the king of shooting places, the gem of all the many sporting centres in the Highlands of Central India. Imagine an ancient mango grove, situated on the edge of a thickly wooded stream, just where it widens out into a large deep pool. It is but a small oasis in the midst of a vast extent of jungle, which goes to make up the Bhowarghar forest reserve. On the opposite side of the stream a sheer precipitous cliff rises straight up towards the heavens, crowned by the now dismantled fort of Bhowarghar, for many years an impregnable mountain fastness. Nigh unto the camping ground is the little forest village of Kathawari, the ruler of which is Jabli, the Gond, *shikari*; and with him dwells none other than his kith and kin, all keen sportsmen and real junglemen. Kathawari is, in fact, a Government forest village *par excellence*, and Jabli and his men exercise a despotic control over this

corner of the Government reserve. Upon them devolves the duty of patrolling the forests; it is they who see to the upkeep of the boundary lines, and prevent the commission of offences; and, above all, it is they who most successfully fire-protect these vast areas. Moreover, their jurisdiction extends to an even greater extent over the wild animals of the jungle. With Jabli on one's side the Kathawari forest becomes alive with game; sambher, cheetal, and in the old days even bison, since exterminated by foot and mouth disease, come forth to meet one. A stranger, or Jabli against one, and at once not a living thing appears to ever stir through those forests. But the "*pièce de resistance*," "*the plat du jour*" at Kathawari was invariably tiger. It has long been renowned as the one place in India where tiger is a certainty, always supposing that one visits the place at Jabli's invitation. There are three trees to which the decoy young buffalo may be tied; there are three well-known beats; three trees on which one's "*machan*" may be constructed; and each stop knows his tree. No sooner is one tiger accounted for than a second takes his place. I have seen five tigers in one beat. I have shot seven tigers in one season off the same tree, the same beat. Not only this, but a "*king*" among Central Indian sportsmen, himself, for many years, Jabli's '*ma bap*,' could tell a tale of a severe mauling he received at the hands of two tigers he casually encountered.

Such is Kathawari, and it was with a light heart, already placing a tiger to my account, that I rode up to my tents on the morning of the 17th February 1893. Jabli and his retinue had already gone on to prepare the way, to tie up the three young buffaloes and to do the very necessary *pujas*. I was not surprised, therefore, on arrival, to hear that a tiger had killed during the night, and that the beaters would soon be collected together, and that the *machan* had been tied up to the same old tree. I at once started out with Jabli to prospect. The kill had been dragged into the wood, and a very cursory track round the area only confirmed our conviction that the tiger was lying up, as anticipated.

By this time the beaters had collected together and everything was ready for business. I soon found myself seated on my '*machan*,' the stops were duly posted, and ere long the joyful sound of the beaters came rolling towards me. The *tom-tom*, the ubiquitous kerosine-tin, that deafening din which never fails to send the blood coursing through one's veins, raising one to the seventh heaven of delightful excitement. It is one of those things that one feels, but cannot explain; it is bred in the bone and can never be acquired. One often hears the uninitiated exclaim: "What pleasure can there be in sitting on a tree and having an animal driven up to one, to then loose off one's gun at him? Where can the excitement come in?" And, theoretically, this argument is irrefutable. But as soon as a "kill" is reported, and all arrangements for circumventing the tiger have to be made;

above all, as soon as the first shout of the beater is heard, a blissful, indescribable feeling of excitement takes possession of one, and all one's theories on the subject are scattered to the winds of heaven. "Where is the excitement, indeed? Can you not feel it? If not, I am sorry for you. I pity you from the bottom of my heart. You are unable to enjoy one of the passions that go to make life worth living." It is the same feeling which sways all true lovers of the terpsichorean art as soon as a dreamy valse is played. Or, again, it is the same impulse which drove the sporting parson of old, of whom we read—

"The village bells chime, there's a wedding at nine,
And the guests to the Church do repair.
At the altar side by side stand the swain and his bride
And the parson unites the fond pair.
Says he, for your welfare I'll pray,
But regret I no longer can stay,
Now you're safely made one
I must quickly be gone
For I must go a-hunting to-day."

But whilst we have been musing the beat has been approaching, the noise grows louder and louder, and one's excitement has been increasing to fever-heat, so that the whole body is in a quiver. Suddenly, however, the tiger is seen to be advancing stealthily, majestically, through the intervening strip of jungle. Walking along slowly, every few steps stopping to look back in the direction of the beaters. All one's mental excitement, one's fears as to the issue of the contest have now disappeared, and all one's attention is concentrated on the tiger. And, after what appears a multitude of ages, the tiger steps forth, and it is a case of now or never. On this particular occasion the tiger had come out a bit to my right, some 30 or 40 yards away, a lovely shot, but instead of standing, or continuing his slow walk, the tiger, at the critical moment, took it into his head to increase his pace, so that the shot had to be a hurried one. However, the tiger fell over, but before one could say "knife," he was up again and off at a canter. Action and reaction, so we are told, are equal and opposite, and the momentary dejection which followed the excitement just previously experienced, was painful to a degree.

It was, however, only momentary, for soon the beaters came alongside, and the *shikaris*, and my blood was up again. Revenge is sweet, and there was no thought left but for the blood of that tiger: and blood there was plenty about. So before long we were all tracking merrily along, hoping against hope that we should come on to the tiger at any moment. The tiger had taken a line over the hills. There was a dense crop of high grass, but otherwise very few trees, just a few scattered Boswellias and little else. And so we tracked along mile after mile, once or twice there was a "hurrush" and a glimpse was caught of the tiger disappearing over the crest of the opposite slope; but never a shot could be fired. After going along in this way for some three or four miles we found that the tiger had entered a deep, shady ravine, holding

water, forming a sort of well at this spot. It was very narrow, the hills rose up fairly steep on all sides of it, and the thickly covered portion of the ravine, in which water was to be found, was only a few hundred yards in length. There was no doubt then that the tiger had taken refuge in this haven, and Jabli at once suggested that I should go and sit up at the opposite end, whilst he would beat the tiger out Accompanied by a couple of men, an assistant *shikari* and a beater, I accordingly made a long detour, and soon took up my position on the banks of the stream. I myself sat behind a bush on the edge of the stream where the bank was fairly high, whilst the two men were safely ensconced at the top of the biggest trees some little way behind me. Then the beat began.

It was not long before I saw that the time for the accomplishment of my "vendetta" had come. The tiger was walking into the trap set for him. He would soon be at my mercy. These were my thoughts as the tiger stepped out some 150 yards from me, looking very sorry for himself. He seemed to be dragging himself along with difficulty. There he stood for a moment in the middle of the stream, looking back in the direction of the beaters, merely prolonging the agony. Just at that moment a shrill, suppressed whistle broke out behind me, the tiger turned his head in my direction, a second whistle, and away went the tiger off round the corner and out of sight. It takes many minutes to relate, but it all passed in the flash of a moment. There was no time for a shot. I stood mute, dumb-founded; for a moment I was speechless with vexation and disappointment; then the flood-gates of heaven were flung wide open, and a mighty torrent of choicest invectives descended upon the head of that poor grovelling worm and his relatives unto the third and fourth generation. *Fiat justitia, ruat cœlum* is the motto of my up-bringing. Justice was done, and the heavens thundered forth. "Saheb, I thought you had not seen it," was all the miscreant could utter.

And now the beaters came up; they had not seen a sign of the tiger. The shades of night were fast descending; nothing more could be done. And as we wended our weary way home, sad at heart, broken in spirit, dejected, full of disappointment, bursting with an unquenchable fire of anger, ever and anon a mighty oath would rend the air. Then, and for many weeks after, terrible were the curses that were hurled at the head of that whistling mass of iniquity.

"In holy anger, and pious grief,
He solemnly cursed that rascally thief!
He cursed him at board, cursed him in bed;
From the sole of his foot to the crown of his head;
He cursed him in sleeping, that every night
He should dream of the devil, and wake in a fright;
He cursed him in eating, he cursed him in drinking,
He cursed him in coughing, in sneezing, in winking;
He cursed him in sitting, in standing, in lying;
He cursed him in walking, in riding, in flying,
He cursed him in living, he cursed him in dying!—
Never was heard such a terrible curse!"

Next day a careful search was made, and again the day after; but nothing was evermore seen or heard of that tiger. It is presumed that he probably entered some fissure in the rocks, and there died a useless, worthless death—*Requiescat in pace.*

AMALTAS.

Mahseer Fishing.

With the object of acquiring knowledge as to the most favourable hours at which to catch mahseer, I have kept a record during the past year of the fish I have killed at different times of day. If some of your other readers will do the same, and will ask you to publish the results, we shall in time have some definite information on the subject.

My fishing was all done during February and November in the big rivers of Upper India, and almost all of it was by casting from the bank, the rest, less than 5 per cent., having been by trolling from a boat. In all, I was on the water sixteen days, or parts of days, and was actually fishing for a period of 80 hours. The biggest fish caught was 20lbs. in weight, and the smallest was 1lb. The following table shews the results :—

Time of day.	Hours spent fishing.		Number and weight of fish killed.		
	Blank days.	Successful days.	Number.	Weight.	Average weight of fish per hour.
Before 10 A.M. ...	1½	7½	4	16	2·1 lbs.
10 A.M. to 3 P.M. ...	13½	29½	26	197	6·8 „
After 3 P.M. ...	5½	22½	11	81	3·6 „
Total ...	20½	59½	41	294	...

It is generally held among fishermen in India that the middle of the day is the worst time to fish, but these figures tend to shew that this is not the case.

I would add that I fish with an 18' salmon rod and fine tackle, all of my fish having been killed on single salmon-gut, and most of them on "fine" trout line. Of the 294 lbs., 39lbs. were killed with a fly spoon, cast overhead; 227lbs. with an "ordinary" spoon, and 28lbs. with a phantom. I used no dead or live bait, because it was not procurable, and no "hogged" spoons, because I do not believe in them, save in slack water.

PISCATOR.

VI.—EXTRACTS, NOTES AND QUERIES.

Forestry in the Andamans.

A very interesting ceremony took place on January 21st in the public inauguration of the first steam tramway in the Andamans. The line is to run from Kadakachang on Brigade Creek at the north end of Port Blair harbour, seven miles north, until it reaches Shoal Bay, the first creek on the coast north of Port Blair. The object of the steam tramway is to convey Forest Department timber, which is now cut around Shoal Bay Creek, to Port Blair, where the finer "padouk" logs are cut into squares, and shipped to the London market, and the timber unfit for exportation is sawn up and devoted to the needs of the settlement. The day was a local holiday, and various launches conveyed the officials of the settlement to Kadakachang, from whence they proceeded on trolleys along the first two miles of the steam tram line to Wimberleyganj, where a building had been erected for the reception of the officials. The building had been tastefully decorated with flags and palms, and presented a most gay and picturesque appearance. The day was a delightful one, fine and cool, although the night before one of the sudden storms, to which residents in Port Blair are accustomed at all times of the year, had broken with its usual force, and it must have required the hardest work on the part of Forest Department officials to have prevented the decorations from being spoilt, and the whole place from being turned into a morass. The convict band was in attendance, and Port Blair was altogether *en fête*. At 11 A. M. the Chief Commissioner, Colonel Temple, drove up, and entered the marquee and ascended the platform. Mr. R. L. Heinig, the Deputy Conservator of Forests, then read an address, which had been tastefully printed on pink silk, thanking Colonel Temple for kindly consenting to open the steam tram line, and giving a history of the tramway operations in Port Blair during the last ten years, and explaining the present extension. At the close of his remarks the address was presented to Colonel Temple in a handsome silver casket designed in the shape of a log of padouk. Colonel Temple replied as follows:—

"MR. HEINIG AND GENTLEMEN,—Four years ago I had the pleasure of meeting and addressing you on the occasion of the opening of the Chatham Saw Mills, which marked a distinct advance in the progress of the Andaman Forest Department, and I need hardly tell you that it is with still greater pleasure that I meet you all here to-day to mark yet another advance in a department which is of such vital importance to the welfare of the Settlement. And I take this opportunity of repeating here what I had said on the former occasion at Chatham Island,—that it is to the Forest Department we chiefly look for making the Settlement eventually entirely self-supporting. Every step forward, therefore, to that

end is a matter of congratulation to all concerned with the local administration. The establishment of the Chatham Saw Mills effect a permanent saving in labour in converting the timber extracted from the local forests, and enabled us to send to the London market their exceptionally fine products with a greatly increased measure of profit and success. The establishment of the Wimberleyganj Steam Tramway will effect a permanent saving in labour in extracting forest produce, and will, therefore, achieve a further advance in the same direction. I need hardly remind many of those I am addressing to-day that all labour-saving apparatus is of importance here. Our labour supply is strictly limited, and there is so very much to do with it—so very many unavoidable things which must be done—so many which we have no choice but to do—that if we would achieve an advance in any direction of convenience or utility one can think of, we can only achieve it by devising or adopting some means of saving labour. Mr. Heinig has told you that I have all along fostered the particular scheme we inaugurate to-day. This is the reason for my action.

"In furtherance of the views I have to-day expressed, I would like to impress upon all the officials of the Settlement the urgent necessity here for devising labour-saving apparatus or schemes. I hardly know of any better service that any of you can perform beyond your fixed duties to the Government you serve, than in putting forward and pushing through to a successful conclusion a workable scheme for saving labour. I say a workable scheme advisedly, for I need hardly point out that nothing is easier to propose and in the end more unprofitable than an unworkable scheme. But if my remarks to-day result in firing the clearer heads among you to make proposals for saving labour that can be put into practice, this meeting will, on that account alone, not have been held in vain.

"We have just heard a short history of the tramway operations in Port Blair during the last ten years. Between 1890 and 1894 we purchased seven miles of line, which have been set up in three different localities in succession as the need arose, and now we are about to set up seven miles more, with this difference, that the first seven miles were worked by men and cattle, whereas these are to be worked by a locomotive. Now, I have been personally over all the lines that have been made, and can testify to the difficulties that have had to be overcome—difficulties that in the present instance have been enhanced by the necessity for providing easy gradients and curves and a good road for the locomotive. Some of you may remember that in my address on Chatham Island I congratulated the officials here on their self-reliance, their capacity for overcoming difficulties without assistance from outside, their power of adapting themselves to whatever work might be placed before them. The making of these tramways is, I am glad to say, another instance in point. As so many of us well know, it is no easy matter to align a road of any

sort—let alone a rail-road—through a jungle so dense as that of the Andamans, and yet, without asking for any assistance from experts whatever, it has in every case been done well enough for our practical needs. In congratulating Mr. Heinig, Mr. Buchanan, and Mr. Anderson on their share in these constructions, I have great pleasure in expressing my pride that this remote Penal Settlement should be so self-contained—that when the need arises, or the Government of India desires, I am able to say that the work required shall be done, knowing that with the help of those around me, there is no need to demand designs or plans or instructions, because between us the work will be carried through, whatever it may be—a huge building, a tunnel into the sea, a church, a tall chimney, a large reservoir for water, a railway, or a bridge.

"But, gentlemen, we must not stay our hands in order to find time to think back upon past achievements. A place like Port Blair cannot stand still, and we must be always doing. The Forest Officers here know well enough that the short line of steam tramway we are inaugurating to-day is but the mere beginning of one that will in due course have to be many times longer. And so it is with everything that we have to do. We must go on. As most of my hearers know, the demands of the Government of India during the last decade upon our ingenuity, our capacities, our power of work, have been very great, but in the decade to come they will be greater still. There is going to be no rest, and I ask you all to meet the demands that are coming as you have met those in the past. What may be called the second generation of those who have had the making of the Penal Settlement is fast passing away, and before long the whole will have left us. It has fallen to that generation to raise the Settlement out of its first beginnings, to bring about the great penal system that has been left to you to carry on, to construct the many works of which you have the benefit. And in speaking to the rising generation, before which are many years of service here, I would ask them to take stock of the houses they live in, the conveniences at their doors, the roads they travel over, the fields they travel through, the minutely regulated penal system they administer, and then think of what the old generations have done for them, and how well they served the Government that sent them here, with appliances far more meagre than now exist, and material and physical difficulties far greater. If you, younger officials, will ponder these things and profit by them, there can be no doubt that coming from the same race and made of the same stuff, you, too, will so bear yourselves in your time that it may be said of you, as it can be said of those now passing from us, that in these islands they have changed the face of the earth.

"And now, gentlemen, I will detain you no longer than to express my satisfaction at hearing from Mr. Heinig that Mr. Viney has cordially given him valuable assistance, and that good

work towards the present undertaking has been performed by the Deputy Rangers, Hassan Ali and Mohan Lal."

The close of the Chief Commissioner's speech was greeted with applause, and Mr. Man, Deputy Superintendent, called for three cheers for Colonel Temple, which were heartily given. After the locomotive had been inspected, all present adjourned to the Forest Bungalow at Wimberleyganj, where the whole station was hospitably entertained to breakfast by Colonel Temple.

A return by trolley and launch was made about 2 P. M., after a most interesting day.— *Pioneer.*

Development of Forestry in the Soudan.

The Anglo-Soudanese Government has taken up the question of the development of the vast Soudanese forests, which may be a very possible source of future wealth, and an export in forestry from Burma has been appointed to study and report on the best methods of introducing improvements and utilising this potential source of wealth. Mr. C. E. Muriel, Deputy Conservator of Forests in Burma, has, with the consent of the India Office, joined the Anglo-Soudanese Government for one year, the unexpired portion of his furlough. Mr. Muriel arrived in Cairo on Wednesday from England, and will shortly proceed to the Soudan.

Sir William Garstin, in his report on the Soudan, says :—

" It is very much to be hoped that a scientific examination of the Soudan forests may ere long be carried out under the superintendence of an expert. An Indian Forest Officer (from Burma for choice) might be deputed for this purpose. It is certain that much valuable information would be obtained from his report. Such an appointment needs no recommendation—its necessity is obvious. A trained Forest Officer could, moreover, render good service by advising the Government as to the best method of preserving the valuable fuel-supply which at present exists on the banks of both rivers."

Although it is only a little over a twelve month since the report was published, the advice has been acted upon, and it is to be hoped that some serious attempt will be made to restrain the enormous waste of most valuable trees that now goes on. The supply, although apparently inexhaustible, must speedily diminish, unless the cutting and felling of the areas is carried out upon some regular system which will permit of the young trees growing up and replacing those cut down. It is, of course, inevitable at present that the felling should be carried out in a wasteful manner. Fatigue parties are landed from the boats and are required to cut the largest amounts of wood in the shortest possible time. The men have no idea of the value of the trees, and naturally select those which are nearest to the water and easiest cut. Should this practice be continued, it is certain that a few years must see a great diminution in the belt adjacent to the river. On the Blue Nile, even the valuable gum-producing acacias are being felled for fuel.

The vast forests of the Soudan line the banks of the Upper Blue Nile and extend, in an easterly direction, to the Abyssinian frontier. In the Bahr-el-Ghazal Province also, particularly in the Bongo country, large forest tracts exist. The ebony tree (*Dalbergia Melanoxylon*) is met with south of Karkanj, on the Blue Nile, and again in the vicinity of the Sobat River. This tree does not, in these latitudes, attain to a very large girth, nine inches being apparently its maximum diameter. It must, however, be very common in these forests, as most of the principal houses in Omdurman are roofed with it. The vale of the Acacia Arabica, from which the white and red gum is obtained, is well known; while the other kinds of acacia, such as Acacia Nilotica (in Arabic, "Santh"), is the chief source of the fuel supply. The bamboo is met with in the ranges of hills to the south of Famaka, and, according to some, the mahogany tree is found in the forests round Fazogl and in the Beni Shangul country. The means of transporting such woods can only be by the river. Unfortunately neither the ebony nor the acacia will float in water, and, therefore, such transport is debarred in these cases. If a good and serviceable timber tree can be discovered in the Blue Nile forests, which can be floated down the river to Egypt, a large source of revenue will undoubtedly have been found. Extensive saw-mills might be erected at Assouan, utilising the power available at the dam, now under construction, and an important timber trade might one day rise.

On the White Nile, in the Bongo and Rohl districts, the India-rubber creeper *(Landolphia floribunda)* is found in great profusion. If the rubber yielded by this creeper be not of quite so good quality as that obtained from the India-rubber tree (*Ficus elastica*), it is still of sufficient value to be counted as an important asset in the future trade of the Soudan. This plant, which has large laurel-shaped leaves, and a white flower resembling a jasmine, requires several years to mature before yielding rubber in any quantity. The natives obtain what they require by tapping the stem, usually in such a reckless manner that the creeper dies under the operation. The India-rubber tree should certainly flourish well in most parts of the Soudan, more particularly south of Khartoum. Although this tree takes from twenty to thirty years to arrive at a girth sufficient to permit of regular tapping, its yield is so valuable (about 3l. per tree per annum), that its introduction into the country is well worth attempting. The above brief resumé fully shows the necessity of beginning a careful study of Soudanese forestry. It will be long before the Soudan will have a Woods and Forest Department organised on the Indian model, but the Anglo-Soudanese Government is to be congratulated on having secured the services of an expert, and we shall look forward to Mr. Muriel's report with great interest.—*Egyptian Gazette.*

[We are glad to be able to inform our readers that Mr. C. E. Muriel, I.F.S., is writing an article on his experiences whilst exploring the Soudan forests, for publication in our Magazine.—HON. ED., INDIAN FORESTER.]

A Year's Botanical Work in Madras.

In prescribing a revised Agricultural Department for Madras, the Government of India sanctioned a Government Botanist for that Presidency, and limited his term of office to five years, after which his services were to be made available elsewhere. The chief aim of his work was to make a systematic survey of the flora of the South in consultation with the Director of the Botanical Survey of India, in order that the work may be co-ordinated to the requirements of the latter's Department, and in furtherance of a programme of collection of specimens to be made for the Indian Museum and Imperial Institute, also to advise on subjects connected with economic botany. The officer loaned to Madras for this work was Mr. C. A. Barber, and his first complete year's work is recorded in full in the Operations of the Land Records and Agriculture Department of Madras for the official year 1899-1900. During the period Mr. Barber travelled from Tinnevelly to Ganjam, and made collections in seven Madras districts, adding some 2,000 specimens to the Herbarium at Ootacamund. His economic work, which was made subordinate to that of the survey, consisted of investigations into diseases affecting the sugar-cane plantations and sarghum fields and the causes of the alleged deterioration of the ground-nut trade of Madras. Among smaller matters in the same direction, he examined the parasites said to attack the roots of the older cinchona trees on the Nilgiris, and the presence of elivorius among seedling plants in the tea estates of the Wynaad, which Dr. Watt regarded from an alarmist point of view during his recent tour in the south of the Peninsula.

Economic work is undoubtedly the legitimate occupation of a Government botanist, but as the chief reason for his engagement in the present instance was the completion of the Imperial Botanical Survey of Southern India, he necessarily devoted most of his time and attention to the latter. But the experience of the year has shown that the collection of specimens may be carried on with equal efficiency by an Assistant, and it is, therefore, in contemplation to provide Mr. Barber with such an Assistant, after which he will be in a position to carry on both branches of his work simultaneously. Considering the great attention now paid to economic botany in all parts of the world, and the increasing keenness of competition in such industries as tea and coffee, much useful work can be done in this Department, and it would be a mistake to treat it as of secondary importance as first intended.

In the Department of Systematic Botany, Mr. Barber made excursions during his travels into the evergreen, the mixed and the deciduous forests of Madras, and thence obtained valuable additions to the Herbarium, and to the knowledge of the plants of the Presidency. He investigated the desert and the sea-side flora as well, thus covering a great variety of country, and collecting

the growths of all times of the year. Referring to what he gathered in the extreme south, he remarks upon the interesting fact that several plants of the island of Ceylon were met with on the mainland adjoining which had not previously been recorded for Southern India. The leafless sal forests, too, further inland and northward, that so exclusively take possession of the soil to the exclusion of undergrowth, yielded him as many as a dozen plants new to the Peninsula—the more striking this because the same ground had been worked over for a much longer period than he found it possible to devote to it by so competent a botanist as Mr. Gamble.

What little has been already done in such widely different regions, Mr. Barber thinks is promising, and he hopes that a fuller exploration of intermediate tracts will produce results of high scientific value. In the west and south of the Madras Presidency, Mr. Barber remarks there are masses of country practically unexplored which will afford him occasion for many visits at different times of the year. The actual work of classifying the 2,000 specimens he has collected in the field has not, he says, made great progress. This lot alone he estimates will fill 6,000 sheets, and as no more than 25 sheets at present can be examined and added to the Herbarium per diem, it will be seen, he thinks, that his work indoors is cut out for him for some considerable time.

The year has been one of much sickness among his working staff, all but one having suffered from malarial fever contracted by going into jungles at unhealthy seasons. He hopes in future, however, to have men habituated to the unhealthy tracts in which his work will be conducted, and thus to escape the hindrances he has experienced from this cause. Another difficulty to his work, to which Mr. Barber adverts, is the want of a good botanical library at Madras—similar to the one that exists at Calcutta. He deplores the fatal mistake made at the time, of permitting the late Mr. M. A. Lawson's library to be dispersed. A complete set of works on Indian Botany might have been secured had the Madras Government taken possession of the effects of the deceased; but the opportunity was lost, and the work of reconstructing a library of reference has now to be undertaken which will necessarily be slow, and retard much useful work meantime. It is of little use to have an excellent Herbarium, as the one at Ootacamund is fast becoming, unless it is supplemented by a good library. The Herbarium, however, has its use, but its errors, which cannot be avoided, cannot be rectified unless resort can be had to final reference in the form of a complete and efficient library. Mr. Barber, in speaking of errors in the Ootacamund Herbarium, the work of the late talented botanist, is careful to prevent any reflection upon the memory of Mr. Lawson, without whose labours, he says, the confusion in it would have been infinitely greater; as the alteration of a single specimen from one cover to another frequently entails hours of study and patient effort.

To prevent errors arising from the accumulation of difficult specimens from which the "plums" in the shape of new species may be expected to be drawn, Mr. Barber suggests that he should be allowed to make annual visits to the Government botanist at Calcutta. This is an excellent suggestion and one sure to be sanctioned, since the Madras Government has already assented to the principle of such visits.

Not the least interesting of the enquiries conducted during the year by Mr. Barber is that of the grasses of this country. He says that he entered into a correspondence with the Agrosolologist of the United States Department of Agriculture, and obtained from him specimens of some 180 named North American grasses, some of which being adapted to nearly all the countries of the world, from the sand-binding species of tropical seashores to those forming the verdure of temperate meadows, should have representatives in India. About 50 specimens of grasses have also been received from Mysore which enrich the Herbarium collection. As most of Mr. Barber's enquiries made into economic products have already appeared in the form of bulletins, it is not necessary to reproduce this part of his Report in this article. Enough has been adverted to, to show that Madras has in Mr. Barber a valuable acquisition—and that his labours are bound to prove of great scientific value to the Department of which he is a member.—*Pioneer.*

California's Big Trees.

The Forester of the Department of Agriculture, Mr. Gifford Pinchot, has just written a most interesting account of the "Big Trees" of California and the danger which menace them. Before the glacial period the genus called Sequoia flourished widely in the temperate zones of three continents. There were many species, and Europe, Asia, and America had each its share. But when the ice fields moved down out of the North, the luxuriant vegetation of the age declined, and with it the multitude of trees. One after another the different kinds gave way, their remains became buried, and when the ice receded just two species, the Big Tree and the Redwood survived. Both grow in California, each in a separate locality, the Redwood occupying a narrow strip of the coast ranges ten to thirty miles wide, and extending from Oregon to the Bay of Montery. The Big Tree (*Sequoia Washingtoniana*) is found in small groves scattered along the west slope of the Sierra Nevada Mountains. There are ten main groves or groups of trees, and the number of specimens figures up some thousands, but only 500 are remarkable for their size.

The Big Trees are unique; they are the oldest living thing, and are the most majestic of trees, and are extremely interesting from a scientific point of view as being the best living examples

of a former geologic age. Their vitality is remarkable, the fungus is an enemy unknown to it, and the best specimens have been found to be sound at heart when felled. These great natural curiosities have only been able to hold their own by reason of favourable climatic conditions. The Mariposa grove is the only one which may be said to be entirely safe, and most of the other groves are being destroyed. The finest of all, Calaveros Grove, which has the tallest trees, has been bought by a lumberman. The Sequoia and General Grant National Parks are eaten into by private claims. In brief, the majority of the trees are owned by men who have the right, and in most cases the intention, to fell them.

The Calaveros Grove was discovered in 1841 by John Bidwell, and by 1870 the majority of the big trees had been located. One of the largest examples in the Calaveros Grove was cut down in 1853; the bark was 15 to 18 inches in thickness, and after stripping this off the diameter of the trunk was found to be 25 feet at a height of 6 feet above the ground; it was 302 feet high. It was found to be impossible to fell it by ordinary means, so the trunk was bored by pump augers of large diameter. This occupied twenty-two days, five men being employed, and at the conclusion of their labours it was found that the tree would not fall, so two and-a-half days were consumed in driving in wedges; the men then retired for dinner, and a gust of wind blew it over, nature apparently wishing to prevent the hand of man from consummating this last act in a great tragedy of the forest. The bark was used to form a room in the old Crystal Palace at South Kensington. A cotillon party of thirty-two persons danced on the stump. Another tree, called "The Mother of the Forest," was 321 feet high and 137 feet to the first branch. It is estimated that there were 532,000 feet of sound inch timber in the tree. The "Father of the Forest" was about 400 feet high when standing, and its circumference at its base was 110 feet. A number of the living trees have been named, and most of them are marked with marble tablets.

There are 1,380 Big Trees in the Stanislaus or South Calaveros Grove, including "Smith's Cabin," in the charred hollow of which a trapper lived for three years, and where he occasionally also stabled his horse.

The "Canal Boat" is a decumbent tree. The upper side and heart have burned away; in the bottom thousands of young big trees have started. In the Mariposa Grove is a tree through which a road has been cut.

Unfortunately, the Big Trees are exquisitely proportioned, and are the noblest specimens which the botanical world can offer, and for this and by reason of their extreme age, they ought to be protected from Vandals. Many of the Big Trees are estimated to be 3 600 years old, and 4,000 rings have been counted. Under the most favourable conditions these giants probably live

to be 5,000 years old, and even more. They seldom die natural deaths; they seem to be exempt from the diseases which afflict other trees. Their worst enemy is man, then comes fire, lightning, storms, and the giving way of the ground on which they stand.

Fossils show the Big Tree to be the remnant of a once numerous family, it is a direct or collateral descendant of ancient species. Their ancestors formed a large part of the forests which flourished throughout the Polar regions, now desolate and ice-clad, and which extended into the low latitudes of Europe. The natural reproduction of the tree is slow, and the preservation of the race is dependent on maintaining the present groves intact. The Big Tree rejoices in five names, which have been given to it at various times; Sequoia Washingtoniana, however, which was proposed in 1898, will probably be the name under which it will be known. *The big tree has been introduced into England* and the Continent, and while it has done well, it shows that the existing climates do not suit it, and the Sierra forests need fear no rivals. It has been occasionally cultivated in the Eastern United States, where it does not flourish. There are two trees 35 feet high in a nursery at Rochester, N. Y.

The lumbering of the Big Tree is very destructive. The enormous size and weight of the tree naturally entails considerable breakage, and the brittle trunk is liable to be smashed by any inequalities in the ground. The loss from this cause is great, but it is only one of the sources of waste. The great diameter of the logs, notwithstanding the lightness of the wood, causes their weight to be so enormous that it is impossible to handle many of them without breaking them up. For this purpose gunpowder is used, and the fragments are often of wasteful shapes, and unless great care is used in preparing the blast, a great deal of the wood itself is scattered into useless splinters. At the mill, where waste is the rule in the manufacture of lumber in the United States, the big tree makes no exception. This waste, added to the other sources of loss, makes a total probably often considerably in excess of half the total volume of the tree. The big tree also stands, as a rule, in a mixed forest composed of many species, and the destruction caused by the fall of one of the enormous trees is in itself great, but the principal source of damage is the immense amount of *débris* left on the ground, a certain source of future fires. This mass of broken branches, trunks and bark, is often 5 or 6 feet thick, and necessarily gives rise to fires of great destructive power, although the Big Tree wood is not specially inflammable. The devastation which follows such lumbering is as complete and deplorable as the untouched forest is unparalleled, beautiful and worthy of preservation. Fortunately, much of this appalling destruction has been done without leaving the owners of the Big Trees as well off as they were before it began.—*Scientific American.*

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Some First Impressions of an Indian Forester in Upper Burma.

BY S. E. W.

It is easy to understand that the Forest Officer fresh from Cooper's Hill College arriving in Upper Burma on his first visit to the East, should be enraptured with the beauty of scenery and vegetation, and interested both in the new manner of life and in the other novelties with which he is surrounded. He lives an unfettered and peaceful life in the open air outside the stress and hurry of existence further West; he becomes accustomed to the equable, if unhealthy, climate; and he enjoys the feeling of superiority as he roams, the sole representative of European civilization, amongst the simple and respectable inhabitants of the jungle villages. He even adopts some of the customs of the country, and is influenced, perhaps insensibly, by the natural train of thought; in particular, is he prejudiced against the native of India—with the Burman a not unnatural sentiment when regarding the members of a race who were employed in the annexation of his country, who continue to garrison it, and who, thanks to their superior industry, may probably in the future people it,—a sentiment, however, without excuse in the case of an European who has no knowledge of the poor Indian beyond that gleaned in intercourse with his own domestics, generally taken from a class of men who would, with difficulty, find employment in India, and yet here command high wages. This misdirected dislike to the inhabitants of an unknown country has as its natural sequence a distaste to the country itself, and after a few years'—in very pronounced cases a few months'—residence in Burma the young official sturdily resents every attempt at uprootal from the locality of his first introduction to Eastern life. There can also be no doubt that the change at first would be sufficiently startling to him!

Let us consider the case from the other point of view. An Indian forester is suddenly transferred to Burma; for years he has been accustomed to tour the forests with what he there considered to be the bare necessities of his life and position, with two sets of tents, with horses, elephants, with a full complement of servants; there he prided himself on the simplicity of his surroundings; he finds it here to be unattainable luxury. His charge in India was more or less in working order: there was a suitable subordinate staff, roads, wells and working-plans; there was shooting, perhaps a little fishing; it was in the day's work to ride, well mounted, 20 miles or more in a morning to see that fire conservancy arrangements were in order, to visit the fellings and other forest operations in which he took a personal as well as a professional interest. He arrives in Burma; his charge is ten or even twenty times as extensive as in India; there is no staff to work it efficiently; there are no roads: the reserves are isolated blocks of rugged hills scattered over thousands of square miles of country; to visit them all the refinements of life must be abandoned, the forester must perch his scanty kit on two elephants and tramp wearily day after day through never-ending forests in which it is impossible to take a sustained interest, for they are valueless, uncared for, and contain little or no animal life. When to these conditions it is added that a want of knowledge of the language removes one of the chiefest pleasures in intercourse with an amiable and fascinating people, that an unaccustomed climate produces the usual inconveniences; when it is found that no expenditure can ameliorate the physical hardships of the life, that professional attainments can be put to little use, it may well be understood that the first impressions of the Indian forester in Burma fill him with despair, and with the fear that all the enjoyments of life, as he understands them, have been rended from him. In time he realizes that the joys of competition and emulation do not exist in Cathay; that the energy and progress of the West can cope but slowly with the good-humoured indolence of Burma, and that in a country where District Headquarters have weekly posts, and where an official can only crawl about at the rate of 10 miles a day, one must be content to do the best one can in the circumstances and happily cease from fretting if the best is not all that could be wished.

Having arrived at this suitable frame of mind, it is interesting to regard one's brother officers, who for the most part have never passed through this struggle. The persistent patience that actuates them in the discharge of their duties cannot fail to arouse admiration; but the still incompleted exploration of the country, the extension of reserves, the size of the divisions,—all these conditions coupled with, for the most part, the utter ignorance of subordinates, have induced a habit of continuous roaming common to all, in some so accentuated that a day's halt is irksome and produces a feeling of unrest and dissatisfaction. It will be

understood that in such circumstances detailed work in the forest is impossible, and that until the time arrives when an officer has leisure to become intimately acquainted with selected areas, there can be little advance in sylvicultural knowledge as regards the habits and requirements of the principal species, and little aid can be given to the improvement of the forest growth.

The country is sparsely populated, hence labour is scarce, and what is available is unwilling. When a man can till as much land as he wishes, and when the raising of one crop will maintain him for twelve months in what he considers to be comfort, it is not surprising that he should refuse to do a day's work even for the sum of eight annas which he does not want. For, with the Burman as with the European, money can as yet bring no perceptible increase in the luxuries of life. The result of these conditions as they affect the forest is, that works of improvement are difficult to carry out.

It must not, however, be imagined that so much stress is laid on the importance of these works as is the case in India. There the price of timber is regulated by the ease of extraction, and it pays Government to construct roads, slides, tramways, even, in the case of a sustained yield, railways, in order to obtain an enhanced price for forest produce. Here, on the system of monopolies granted for long terms to private firms, the opening out of forest communications by the State becomes unnecessary, and in consequence the price of good teak timber averages about 8 annas per cubic foot in the forest against 12 annas and more per cubic foot obtained for "sâl" timber from inferior trees in improvement fellings in Upper India. And such is the closeness of these monopolies that local merchants are not permitted to extract teak to be sold outside the limits of the upper portion of the province. By this absence of competition, by the omission to invest capital in the improvement of communications, the price of teak timber as paid to the Forest Department remains fixed for a term of years outside the fluctuations of the market, and interest in the State forests by the local population receives no encouragement. Yet the policy which removes the necessity for improvement of communications by the State does not interfere to minimize the importance or prevent the construction of inspection paths, the extension of fire conservancy, and the provision of suitable shelter for the staff. Rather must we explain the backwardness in this respect by the fact that the establishment is both inadequate and ignorant, and that the controlling officer, if these works are to be carried out, must give them his constant and personal attention to the detriment, perhaps, of other equally urgent business. In Burma one may hear the Forest Officer say that neither he nor his staff know anything about fire conservancy, house-building or rock-blasting, forgetting that these and similar occupations are part of the forester's work and education, and that this ignorance is a confession

that there is no time either to train the subordinates or to maintain and improve by practice the elementary knowledge acquired in a College training. On the other hand, the Forest Officer in Burma will spare neither time nor health in the carrying out of the work allotted to him. In girdling, surveying, demarcating, measuring timber he will sacrifice himself in a way that is often sad to contemplate when it is considered that his proper place is that of supervisor, and that most of this kind of work could be as well and more quickly carried out by a trained staff, better able also to withstand the exposure and inconveniences involved, whilst at the same time the educated forester would then be set free to direct those operations necessary for the improvement, in some cases even the continuance, of the already settled State forests. In the Burma Forest staff one often sees splendid material utilized much below its ability, but in the absence of working-plans, of well considered schemes for improvement, of a trained subordinate establishment, it is not surprising that the officers of the controlling staff have often to expend time and energy in carrying out what is really the legitimate work of their non-commissioned officers. Such are a few of the first impressions with regard to one's fellow-workers in Burma; yet more vivid than these remain others most ineffaceable and lasting—those of welcome and aid in a strange land, of kindly hospitality and of eager unselfishness in forwarding the welfare of the forests and of the Department.

The first impression produced on the new-comer by the forests of Upper Burma is that of vastness. From Mandalay to the boundaries of China they roll in interminable billows of vegetation; in the valleys you are buried in forest; from the hill-tops you see nothing but trees. The few thousand square miles of cultivation, the relatively small area of reserves are swallowed up in this sea of jungle. In one district it is calculated that there are about 2,000 square miles of cultivated land, about one-half that area of reserves, and the remaining 17,000 square miles is forest; villages are 6 and 8 miles apart; the population is about 6 to the square mile. Increase this population up to even 250 to the square mile over four-fifths of the district, and what would be the local demand in forest produce and the revenue from the remaining 4,000 square miles of forest? For, besides teak here grows timber larger by far and in quality superior to all but the very best in India—it grows and dies. Here, too, is soil and water as good as may be desired; all that is lacking is the force of man, sufficient and well directed; the effects of this force is even now evident on the hillsides around; they are patched with irregular areas of young growth marking the localities where shifting cultivation has been practised. Man destroys the timber, but is not yet numerous enough to eradicate the vegetation; the forest closes up behind him so soon as he retires with his fire and axe.

One's thoughts next turn to the unexampled opportunity of creating State forests that is presented in this country yet in its infancy. The forester has already taken the first steps by reserving and continuing to add to reserves the teak-bearing areas, by in some places restricting the practice of shifting cultivation where this threatens to affect the permanent water-supply in the valleys below. The work is progressing; it will be many years before it is completed, and then with the increase—happily also the influx—of population the time will also arrive when reservs of the less valuable timber will be settled; when arrangements will have to be made in this country of mountains to prevent the too rapid passing of the rainfall and the denudation of a thousand hills. If this work continues as it has begun, Burma will, fifty years hence, indeed, be a model province from a forester's point of view.

From generalities the forester turns to details; he examines with curiosity the state of the forest growth, especially in the areas already permanently settled; he is struck at once with the inequality of the stock. Trees of the highest girth class are frequently in excess of those in the next lowest class; they are also lamentably frequently unsound; reproduction is scanty, often wanting. He searches the reason for this unsatisfactory state of affairs, directing naturally his attention to the most valuable species. He learns that in the olden times the order to girdle so many trees in such a forest was transmitted by the prince to his deputy, thence through the village headman to the villagers, who killed the required number of stems within the smallest and most accessible area, to the rejection of those individuals whose unsoundness, size or other difficulty of removal rendered them unsuitable. Hence the pressure upon the sounder and smaller trees of the second class; whilst at the same time the advance growth suffered from the abstraction of myriad of poles so adapted to the style of house-building in Burma. The unsoundness of the timber the observer finds to originate from the base of the stems; it is due to the continued wounding of the bark by the succession of forest fires, which gain no height or intensity owing to the scanty undergrowth, but whose reiteration is still sufficient to injure the seedling and prevent recovery in youth or old age. The absence of teak reproduction is referable to various causes—in unprotected areas it is due to the yearly destruction by fire of the seed and the seedling; on steep and bare hill slopes to the deterioration of the soil by the removal of the undergrowth from the same cause, accentuated here by the reckless felling of the sound trees under native rule; in protected and moister forests the shade thrown vertically by the canopy of the mature stock forms a sufficient determent to the germination of the seed and continuance of the seedling; nor have the attempts at uniformly lightening this shade over the whole of any forest area yet had any beneficial effects. In bamboo undergrowth, so frequent in the forests of Upper Burma, teak will grow, but only where the clumps are sparse,

and thus do not continuously darken the ground with the dense lateral shade of the thick clumps. Frequently one observes teak seedlings under the shifting shade of the waving culms; they emerge from this shelter and are checked and distorted by the now nearer direct vertical shadow thrown by the foliage of some forest giant who should have no place in the scheme of working the forest. Plantations there are where teak closely sown grows, but rarely thrives; they are the play-grounds of wild elephants. In other places shifting cultivation is utilized as a means of extending the teak area; but this system so successful in Lower Burma will hardly affect the extension of teak forests in the Upper Province, where natural reproduction can surely be induced by protection and other aid.

The habit of teak in these hills is identical with that of many other forest trees in India. The mature stems stand more or less in groups; they permit of no young growth of the same species in their shade; the death or removal of a group of such stems should be the signal for the recommencement of another cycle of tree life, for the germination of a group of seedlings, for the gradual formation of another group of trees. If this impression is correct, we have an explanation of the fact already mentioned, that attempts at a uniform lightening of the canopy have no appreciable affect on the progress of regeneration; we have further a suggestion for the treatment of teak-bearing areas where reproduction is hampered by teak overgrowth, by miscellaneous species or by bamboo; for by letting in light in small patches scattered over the forest we shall be following nature and at the same time avoiding the disastrous consequences of clear felling over large areas.

The bamboo forests of Upper Burma are of the most beautiful; and, moreover, they supply the inhabitants with all they require in the hundred-and-one necessities of daily life; from the bamboo are fashioned with the ever-ready "dah," houses, bridges to flower baskets and lacquered boxes. But from a forester's point of view the bamboo is in excess and causes obstruction; they are difficult to remove, and yet must at times be got rid of in the interests of superior growth. The method of removal will doubtless form an interesting subject of investigation to the Burman forest officer; it is possible that the standing clump may be amenable to vital injuries by fire artificially applied, though we know by experience in "taungya" clearings that slow fires do not kill the roots of felled clumps satisfactorily.

There are yet other first impressions which will remain as reasured memories for future years; of monsoon trips on flooded rivers, bordered with the full luxuriance of tropical vegetation; of winter voyages on shallow streams with the cold mists obscuring the ruddy cliffs and shimmering sand banks; of fierce heat by day and night in the south and of dew and cold in the northern forests. Of these it needs not to write here.

First impressions soon fade in the monotony of things seen and heard for the hundredth time, yet to record them may be interesting to the reader as it certainly is to the person impressed; for, if correct, there is the satisfaction of having inferred rightly; and, if not, then the abandonment of first theories yet implies the acquisition of a maturer judgment and experience.

To the forester interested in his profession a visit to Burma must always be of the greatest value; it is not too much to hope that, in the future, every Indian forester may be given a chance of prosecuting his studies in this province, as well as that every Burman forester may have an opportunity of becoming acquainted with the methods and progress of sylviculture in India. Only let either be free from prejudice, with body strong to withstand and profit by the change, and with mind eager for the reception of new facts and new ideas.

Insufficiency of the World's Timber Supply.*

During the last 30 or 40 years there have been great changes in the conditions under which forest produce is brought to market.

Before the great development of canals and railways, which has been the characteristic feature of the latter half of the nineteenth century, the only economic means of transport was by ships on the sea or by boats and rafts on the rivers. As soon as it became necessary to go far from ports and rivers and make use of land transport, it was found that a very short lead soon ran up the expense to the full value of the wood. Timber, in fact, is weight for weight one of the cheapest materials and the most cumbersome to carry,. Forty kilometres (24 miles) is about the distance at which the cost of carriage equals the value of the produce when the latter is firewood. On mules, 20 kilometres is about the limit. For transport to greater distances it is necessary to convert wood into charcoal, thus economising four-fifths of the weight. Wood used for construction and industries, although its greater value permits of a longer lead, can still not be diffused very far when the transport has to be by road.

The result of this was formerly a state of comparative isolation and independence among the wood-producing countries. The distance and the cost of transport guaranteed them against competition each in its own markets. Each had its clients or constituents, varying in number and importance according as its internal means of transport were considerable or the reverse; great was the advantage if it possessed a large river system leading to a great centre of population.

This is no longer the case. Europe and North America are covered with a dense network of rail and canal that is becoming

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* "*Insuffisance de la production des bois d'œuvre dans le monde,*" par A. Mélard, Inspecteur des Eaux et Forêts. Published by the Ministry of Agriculture (Administration des Eaux et Forêts) of the French Republic. Printed at the Imprimerie National, Paris. Free translation by F. Gleadow, I.F.S.

closer and closer. Low railway rates allow wood to be carried to great distances. Ships, with their carrying capacity trebled by steam, now transport timber to the ends of the earth at remarkably little cost. So that the production and sale of wood is now subject to the general tendency which is fast bringing the whole world into a state of common solidarity. It is no longer sufficient for the forester, the wood-merchant, and the landowner to have a thorough and minute knowledge of the markets of his own locality, province, or even country. Henceforward their vigilance must extend to the markets of the other countries of the world.

From this point of view it is easy to see the importance of collecting data to assist in forming a sound judgment alike as regards the production and the consumption, the present and the future resources, not only of France, but of the entire world. The study is a dry one, for the necessary accuracy can only be obtained through the acceptance of figures and tabular statements, which are derived from the published official statistics of various States or derived from Consular reports. The importance of the matter is enough to salt the dryest of statistics.

In comparing the returns of the timber trade of the great industrial countries of Europe, such as England, Germany, Belgium, France, Switzerland, for different periods of their history, the one striking fact which dominates the whole is the great excess of imports over exports, and the rising and ever-growing increase of the excess.

Hence it must be concluded that the consumption of wood is continually increasing.

This conclusion is not in accord with the opinion of those people who superficially imagine that the use of iron, of steel, of coal, &c., must have reduced wood to a substance of minor importance, and forests almost to an economic nullity. Nevertheless, it is rigorously exact, as will be seen further on.

A very little reflection will arouse the conviction that though less wood may be used as beams, or burned as fuel, than before, there has been no reduction in the quantities required for flooring, joinery, cooperage, packing cases, &c., and that modern developments of trade and commerce have largely swelled the demands for wine-props, telegraph-posts, sleepers, wagons, wood-pulp, &c., &c.

On the other hand, the production of wood is not increasing.

There are, indeed, a very few countries where the forests are treated carefully with a view to increasing their productive capacity. Everywhere else there is a ceaseless destruction of forests. A timber capital whose formation required several centuries, is realised in a few years, and the future production is diminished to a corresponding extent. At the present moment the forest situation of the world is this:—

The consumption of wood is greater than the normal production of all accessible forests. The amount in deficit is being

made up temporarily by living on the capital, i.e., *destruction of forests.*

The situation is extremely grave, and deserves the most careful consideration, not alone of foresters but of economists and statesmen. The forest question, to-day hopelessly flat and uninteresting, is destined before many years to exercise with unpleasant *urgency the minds of the now indifferent though civilised nations.* It may be then too late.

The following rapid review of the principal producing and consuming nations will unfortunately establish the fact that there is no undue or alarmist exaggeration about the warning.

1.—ENGLAND.

The United Kingdom of Great Britain and Ireland (more generally called England), is very little wooded. There are only 1,229,000 hectares* (England 1,103,000; Ireland 126,000), whilst the total area of the country is 31,353,000 hectares. Consequently *the proportion of forest to the whole, the forest coefficient, is less* than 4 per cent. It is about a sixth of the coefficient for Germany (23·3 per cent.) and less than a quarter that of France (17·7 per cent.) For the existing population of 40,200,000 inhabitants, this amounts to no more than 3 *ares* ($\frac{3}{100}$ hectare = ·074 acre, or a tenth part of $\frac{3}{4}$ acre) per head, to satisfy all requirements of housing, fuel, proportion of railways, ships, telegraphs, papers, &c., &c., in short, to supply everything made of wood in the kingdom. England thus provides the merest fraction of the wood she consumes. Consequently her demands on foreign sources are heavy. Among the tabular statement at the end of this work *will be found tables* (1, 2, 3) giving detailed information as to the British external trade in common woods. The following are the most important points to which attention may be drawn.

It may be stated here that, in order to arrive at results comparable among themselves for different countries, it has been made the rule to include, among exports and imports, only the common woods, whether squared, split, sawn, or in the rough, fuel, and charcoal, and to exclude fine cabinet woods, furniture, wooden articles, &c., as likewise minor produce such as cork, resins, and tans.

I.—VALUE.†

Year.	Imports.	Exports.	Excess Imports.
	Francs.	Francs.	Francs.
1894	419,385,726	5,023,370	414,362,356
1895	390,253,007	4,696,947	385,506,060
1896	477,318,764	6,328,782	470,989,982
1897	579,811,381	6,336,096	573,475,285
1898	519,349,255	6,255,316	513,093,939
Averages ..	477,213,623	5,728,102	471,485,524

* 1 hectare = 2·47 say $2\frac{1}{2}$ acres.

† 1 Franc = 10 pence = 10 annas.

II.—QUANTITY.*

Year.	Imports.	Exports.	Excess Imports.
	Metres Cubes.	Metres Cubes.	Metres Cubes.
1894	11,202,122	47,552	11,154,570
1895	10,566,509	50,405	10,516,104
1896	12,172,785	67,851	12,104,934
1897	14,117,316	58,125	14,059,191
1898	12,500,438	60,569	12,439,869
Averages ...	12,111,834	56,900	12,054,934

The exports are insignificant. They consist almost entirely of the re-exportation of foreign or colonial produce. They only reach 1·2 per cent. of the value of the imports and 0·47 per cent. of their volume. The excess of imports, therefore, differs very slightly from the total imports. As seen from the above two tables, this excess has been, on the average of five years, about 12 million metres cubes, worth 171 million francs.

At least two-thirds of the total volume of the wood imported into England consists of converted or prepared materials, planks, scantlings, &c., the volume of which is net, and must be increased by some fraction in order to obtain the real amount grown in the forest. It will be an extremely moderate estimate to take this fraction as one-fourth for the waste. This brings up the total to 15 *millions of cubic metres* in the forest.

Large as these figures are, they will probably fail to carry any adequate picture or meaning to the minds of persons unused to such ideas. It is, therefore, desirable to institute a few comparisons in order that the subject may be seen in its true perspective.

In France, the Forest administration controls 3 million hectares, producing annually about 2,200,000 cubic metres of timber in the rough. The total area of all forests in France is 9,500,000 hectares, producing annually about 6 millions of metres cubes in the rough (firewood not included). The average annual excess of French imports over exports of common timbers from 1894 to 1898, allowing for waste as above, comes to 2,336,000 metres cubes in the forest. Consequently, the average excess of imports into England during the five years is equal to:—

(*a*) nearly seven times the production of the State and Communal Forests of a well-furnished and managed country like France;

(*b*) two and a half times the production of the whole of the French forests;

(*c*) more than six times the deficit of production in France for the same period.

If instead of taking the mean of the five years, the excess for 1897 is taken (a year that was not, as was 1898, troubled by

* 1 Metre cube = 35·6 cubic feet.

obstinate strikes which hampered the whole industrial system), the results are still more alarming, for the figures *mount up to* 17, 600,000 *metres cubes*, of which 16,500,000 metres cubes are coniferous woods, *viz.*, deals and pines. This enormous consumption of coniferous wood is due partly to its comparative abundance in those countries that still possess forest resources, partly to their cheapness, to their lightness, which reduces cost of carriage, and to the ease with which they can be worked. It is an encouragement to grow spruce and silver fir in regions where the climate is suitable.

It may be suggested that the consumption of wood in England has reached high-water mark, and will now decrease. There is nothing to support such an hypothesis, for the consumption is a direct consequence of commercial and industrial vigour, which as yet shows no signs of decline. The future increase may doubtless be less rapid than that of the 40 years past, as shown below :—

			Metres cubes.
1860	...	...	3,850,000
1870	...	...	6,300,000
1880	...	...	9,100,000
1890	...	...	10,200,000
1895	...	...	10,500,000
1898	...	...	12,500,000

It is most desirable that the increase should receive a check, otherwise the figures will become fabulously large, and will result in the complete destruction of all forests and of the supplies of all nations. Nevertheless, it would be foolish blindness to reckon on any diminution of consumption so long as the economic development of England goes on as it is going. The total value of imports, 9 milliards 400 millions francs in 1875, in 1898 became 11 milliards 800 millions. The quantity has increased more rapidly than the value, because the general price of goods, taken as an all-round average, has decreased by 36 per cent since 1875.* The tonnage of merchant vessels, 6,088,000 tons in 1875, reached 8,975,000 in 1898, and the transporting power is even greater proportionately, owing to the replacement of sails by steam. Coal mining produced 134 million tons (metric) in 1875, while in 1898 the output was 205 millions. Lastly, it must not be forgotten that the population of England is increasing by 300,000 annually, and that the housing, employment, means of living, &c., of these new persons requires annually the creation of a new city larger than Bordeaux.

The countries which supply England with wood are principally Sweden, Russia and Canada, which are responsible for two-thirds of the supply, the remaining one-third being provided by

* According to the figures of M. Sauerbeck of the London Statistical Society, February 1899.

Norway, the United States, France, Germany and a few other nations whose contributions are very small in comparison.

[*To be continued.*]

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Sample Plots.

Notes on the Collection of Data as to the growth of trees and tree crops by means of sample plots, with more particular reference to Oudh.

INTRODUCTION.

In the following notes attention is directed to the selection, measurement and up-keep of plots, established, primarily, for the determination of the rate of growth in diameter of the principal species occurring in the forests. Until the knowledge of the rate of growth in height, as well as in diameter, is much greater than it now is, very little progress can be made towards the determination of the increment in volume of single trees and whole crops. The subject appears to the writer too often to be given far less attention than it deserves. The current working-plans in Oudh for the timber forests are of necessity more or less preparatory in nature, but when they come to an end—within the next few years—it is anticipated that plans of a much more permanent nature will be possible. For such plans it is of the first importance that precise and complete information should be available as to the rate of growth of sâl. Perusal of these notes will show whether any of the existing plots can be improved, or whether they are sufficient in numbers; thus the notes may be of value both to Divisional Officers now and to Working Plans Officers in future.

Sâl is chiefly met with in Oudh in forests with all ages irregularly mixed up together. An initial difficulty met with in attempting to study its rate of growth is that there is an endless and ever-changing variety in the outside conditions under which the individuals are growing. It is assumed that there are limits—and fairly narrow ones too—to the effect on the rate of growth of the variations ordinarily met with. Special cases can be studied separately.

The way in which the rate of growth can be determined with sufficient accuracy for all practical purposes is indicated in the following notes:—

Parts I and II deal with the more important details of the plots.

Part III summarizes Parts I and II in the form of a set of rules on the subject.

Part IV is devoted to the treatment of felling coupes as plots with a view to the determination of the class-proportions giving the greatest yield in mature timber. Even if the conclusions arrived at are open to question, the subject is of sufficient practical importance to be worth discussion.

Part V contains a few suggestions for the modification of Article 87 of the Forest Department Code and for the collection in book form, every five years, for the whole of India, of all the information available as to the growth and utilization of trees and tree crops.

Several references are made to the sample plots in the Kheri Division, as the writer is acquainted with them. No unfriendly criticism, however, is at all intended.

The notes are not altogether original. They are gathered from remarks on the subject made by all the Divisional Officers in Oudh, although the writer is alone responsible for the opinions herein expressed.

PART I.

SELECTION OF PLOTS AND TREES.

Selection of Trees.—Should all trees of the important species standing in a plot be measured or only selected ones? The answer to this question in Oudh is that the trees should always be selected.

2. Before proceeding to discuss the above question, a few remarks may be made as to the past history of sample plots in Kheri. Countings of sâl rings yielded no satisfactory results; sample plots for periodical girth-measurements were started near Dudua in 1880 and 1881—

Plot 1, „ 2, „ 3, „ 4	¼ acre each ...	Selected trees, although the choice was not confined to good trees.
„ 5	2 acres ...	An enlargement of plot 4; all trees measured, to study the effect of fellings in 1874-75.
„ 6	... ...	Forty selected trees in and around the Dudua compound.

Although the actual choice of trees made in 1880-81 is open to question, yet the principle of selection was in conformity with the suggestions made in 1880 * by Sir D. Brandis, as Inspector-General of Forests. In paragraph 33 it is remarked—

* Suggestions regarding the working of the Trans-Sarda Forests, Kheri District, dated Simla, 20th August 1880.

> The best trees should be selected for measurement, and these should, as much as possible, be of different sizes.

Paragraphs 33, 34 and 35 of the "Suggestions" are of such general interest that they have been copied at length in Appendix A to these notes.

3. The Trans-Sarda Working Plan of 1892 represents another stage. Under its provisions the Dudua plots were set aside as not being sufficiently representative of the forests, and others were suggested. The exact sites were not fixed, and no mention is made in paragraph 64 as to whether all, or only selected trees, should be measured. The calculations made in paragraph 48 and Appendix D to the Plan are based on *all* trees. "Decayed" trees are said to have been omitted, but this term evidently only included trees that were nearly dead. Whatever may have been

the specific intention of the Plan, seven plots were subsequently started in which all trees are annually measured. Details of the plots are as follows :—

Sample plots—Kheri Division.

Situation.	Year when started.	Total number of trees measured, and still living : by classes.						Total number of trees at all healthy and suitable for measurement : by classes.					
		I.	II.	III.	IV.	V.	Total.	I.	II.	III.	IV.	V.	Total.
C-4	1897	6	15	70	131	..	222	...	5	16	41	...	62
C-7	1894	8	25	84	79	...	196	3	10	44	33	...	90
C-46	1894	5	15	42	66	...	128	1	5	25	34	...	65
C-65	1898	3	4	13	38	8	66	2	1	11	28	6	48
C-70	1898	18	2	38	111	3	172	2	1	33	58	...	94

NOTE.—The plots in C-45 and C-63 have not been detailed, as the numbers on many of the trees have been lost ; the latter plot was given up in 1897.

The figures given on the right hand side of the above table are based on the writer's personal observations for the plots in compartments 4, 7 and 46. It is not asserted that these numbers are absolutely correct, but that they are sufficiently so to make the inference very probable, that, when the plots were started, it was supposed that measurements of *all* trees would be required in the future. It is desirable, therefore, to invite attention to the subject.

4. The forests in Oudh may be looked upon as belonging to one or other of two main groups, *viz.* :—

(i) Timber Reserves--those capable of producing sâl timber of 1st class dimensions.

(ii) Fuel Reserves—those incapable of producing large sâl timber or which are principally required for fuel.

The distinction holds good in all Divisions more or less, although all the details may not yet have been finally worked out.

During the past 10 years "Improvement" fellings have been started in the "Timber" Reserves and Coppice with Standard fellings in the "Fuel" Reserves. The former only profess to be a preparatory measure, paving the way for the introduction of systematic "Selection" fellings in some form or other.

5. The case of the "Fuel" Reserves being the simpler, may be taken first. The "Standards" are intentionally the pick of the stock; hence it is obvious that only the best trees in the untouched coupes should be measured, so that only those trees may be under observation which will ultimately be worth retention as "Standards." As to the coppice crop, the quality of the young stock now growing up under protection will be far better than that it is replacing. It will hardly be denied, therefore, that this crop may be removed (in the second felling cycle) in the time that the better part of it takes to grow (in the first felling cycle). Healthy shoots should, therefore, be kept under measurement and not inferior ones.

6. It is taken for granted that in the "Timber" forests the mature crop may be removed in the time that the next lower class takes to arrive at maturity.

Underlying this is the assumption that the division into the accepted girth-classes of equal range corresponds so nearly to a division into equal age-classes, that there need be no fear of the younger classes not having time to grow up into the next higher classes. With all this may safely be assumed true for the practical purposes of working-plans in the immediate present, pending proof 10 to 20 years hence from the sample plots.

When the "Improvement" fellings prescribed in the current working-plans are completed, the forests will be in a vastly better condition than when they were started. Whereas now unsound timber forms the bulk of the material available for export, it is safe to say that sound material will then be far and away the most valuable part of the outturn. If the above statement is correct, then the rate of removal in the future may depend solely on the rate of growth of the healthy part of the stock; in other words, only healthy trees need be measured in the sample plots. Supposing that the diseased and unhealthy part of the stock does grow more slowly, no harm will be done. For example, assume that healthy class II trees grow to class I in 28 years, whilst inferior ones take 35 years. The felling cycle will be 28 years. As to the healthy mature trees, it is assumed that their places will be filled up from the lower classes within this period; hence there can be no question with regard to them. As to the inferior trees, less than four-fifths will come to maturity within the cycle of 28 years; given a mechanical rule that only trees of 6' girth are to be felled, then more than this proportion will not be removed in the felling cycle. To compensate for the earlier sequence of fellings, fully one-fifth of the inferior stock will be saved up for the second cycle. On the other hand, a felling cycle based on all trees, or on the inferior ones only, would result in loss.

As an illustration of the preceding remarks, the figures worked out during the present year by the writer for the Dudua plots of 1880, 1881 and 1894 may be quoted:—

	CLASS PERIODS ... YEARS.				
	V.	IV.	III.	II.	Total.
Healthy trees	30	27	25	28	110
All trees	42	28	26	39	135

7. A healthy sâl tree can more easily be recognized in the forest than defined on paper. Any trained forester with any experience at all of the species can point out healthy individuals.

Freedom from excrescences and epicormic branches, smoothness of the bark and the condition of the crown are sure signs of the state of vitality. The word "sound" has been avoided, as there are plenty of trees which appear vigorous and healthy from outside, but which are more or less unsound within. The forester selecting the trees in a plot must use his own judgment. Length and straightness of stem, again, need not be considered so much, although fairly tall trees without huge forks low down are to be preferred.

8. *Number of trees to be measured.*—So far it has been assumed that sâl is mature with a girth of 6′ at breast height. This has not yet been proved. In the better parts of Kheri there is every reason to believe that "physical" maturity is not reached under 7′; on the other hand, but to a much smaller extent in the "Timber" forests, there may be areas in which the tree is mature at 5′. Until "physical" maturity of the individual tree is known, "commercial" maturity of whole crops cannot be arrived at. So many undetermined factors enter into the question that, for the present, there is nothing for it but to continue the assumption as to 6′ girth. This being so a girth of 4′ 6″ to 6′ (class II) represents one stage short of maturity. As the rate of progress of the fellings depends on the rate of growth in this class, it follows that trees of class II are of more importance in a plot than others of smaller dimensions. Class III trees are not nearly so important, and as for class IV trees, they need hardly be troubled about at all in this connection.

Reference is invited to the figures given in paragraph 3. These show that the Kheri plots will not be nearly as useful for the next 30 years as they would have been (without increasing the number of trees measured), if only the classes had been arranged inversely to what they are. Too great stress cannot be laid on this matter. The practical requirements of the present generation are of more importance than those of the next. The Working Plans Officer now wants data for class II. Without such data he is no better off than his predecessors, who had virtually to assume a figure for the most important part of a working-plan, *viz.*, the felling cycle. The fewer the *assumptions* that have to be made the greater the outturn as a rule; for one is inclined to err on the safe side when making deductions from insufficient data. Given full information as to the rate of growth of the principal species, such caution becomes unnecessary. As the quality of the stock improves, so also will the importance of this question increase.

9. Before proceeding to indicate limits as to numbers in the different classes, the question may well be asked whether the existing girth-classes are not too large. They have a range of 18″. For sample plot purposes this is too wide. Moreover, there is no upper limit to class I. This should be remedied until the dimensions corresponding to maturity have been determined, especially as 6′ is probably under the mark. Although a range of 12″ would perhaps be small enough, to avoid disturbing the existing

nomenclature, the simplest plan appears to be to adopt a range of 9" by dividing each class into two sub-classes (*a*) and (*b*), thus:—

Class I ...	... Sub-class	I *a*	... 6′ 9″ to 7′ 6″
	"	I-*b*	... 6′ 0″ to 6′ 9″
Class II ...	... "	II-*a*	... 5′ 8″ to 6 0″
	"	II-*b*	... 4′ 6″ to 5′ 3″
Class III ...	... "	III-*a*	... 3′ 9″ to 4′ 6″
	"	III-*b*	... 3′ 0″ to 3′ 9″
Class IV ...	... "	IV-*a*	... 2′ 3″ to 3′ 0″
	"	IV-*b*	... 1′ 6″ to 2′ 3″
Class V ...	... "	V-*a*	... 0′ 9″ to 1′ 6″
	"	V-*b*	... 0′ 0″ to 0′ 9″

All trees over 6 feet in girth should not be clubbed together as in class I; those over 7′ 6″ shoud be treated separately. Recognition of so many sub-classes *is certainly not* an unnecessary refinement in the case of the better classes of sâl forest in Oudh. Besides, it only gives extra trouble at the time of starting plots, not subsequently. *Adopting the above sub-classes, in a typical* plot in a selection worked sâl forest, there should be the following numbers of sâl trees under measurement:—

Sub-class	I-*a*	...	... 5	10
"	I-*b*	...	... 5	
"	II-*a*	...	... 10	20
"	II-*b*	...	... 10	
"	III-*a*	...	... 12	24
"	III-*b*	...	... 12	
"	IV-*a*	...	... 12	24
"	IV-*b*	...	... 12	
Class V	...	...	Special plots.	

10. A slight *ambiguity in terms* may be noticed. It is usual in working-plans to state "*the age of exploitability.*" This is generally taken as being the age corresponding to the lower *limit of class* I. In this sense the term is not synonymous with "*the average age of the trees exploited,*" which, under normal conditions, is equal to the age at the lower limit of class I + half the number of years in the felling cycle. Adopting the figures given in paragraph 6 and assuming that the sâl grows at the same rate in class I as in class II, the average size of the trees felled in Kheri, if the stock were normal, would be 6′ 9″, and the average age 124 years. Under conditions other than normal, of course, variations occur.

11. It will naturally be asked, how is it possible to find on one and the same area the above-mentioned numbers of suitable trees in the different classes, and no more? It may be impossible, but the answer to this objection is, that there is no necessity to limit all the classes to one and the same area. Herein lies a mistake made in the past. The number of trees in each class should not be subordinate to the area of the plots, but the reverse. To decide on the number of trees first, and then to mark off the requisite area, would be very little more trouble than to start with a basis of an area of two acres (in most cases) and to mark whatever trees happen to be in it.

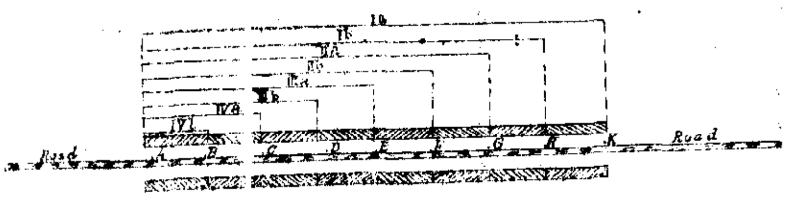
The numbers given in paragraph 9 represent a general case. Each type of forest, it is assumed, ought to have its own plot. If

the type contains few of class I, the numbers in that class may, of course, be reduced. In coppice with standard forests, such as those in Oudh, where it is assumed that class II represents maturity, class I of the standards may be left out of consideration altogether in the sample plots for the Standards, and the numbers in the lower classes may be correspondingly reduced. At the same time in both high forest and coppice forest, if the type has old trees but is deficient in middle-aged ones, the numbers in classes II and III should not be reduced. Let the area for these classes be correspondingly larger instead.

12. *Shape and size of the plots.*—The Kheri plots are 5 × 4 chains. This rectangular shape would be rather troublesome with compound plots having the different classes extending over different areas. In plains forests *linear* plots are preferable. They can easily be laid out and looked after. In most forests there are plenty of narrow roads (8′ to 15″ wide), which would serve as a basis. If not, a line could easily be laid out, either straight or curved, and marked off by a good-sized ditch.

(i) *A road as base*—

Starting from any convenient place A, select the trees for the plot between ½ ch. and 1 ch. of the edge of the road. Trees had better not be chosen within ½ ch. of the road, to guard against any possible effect on their growth of the opening along the road itself.



In the course of about 10 ch. (A—B, say,) the requisite number in sub-class IV-*b* will probably be found. From B onwards mark no more of sub-class IV-*b*. Some distance further on (A—C, say,) sufficient of sub-class IV-*a* will be found. From C onwards mark no more of this sub-class, and so on; in the course of about a mile all the required numbers will generally be obtainable.

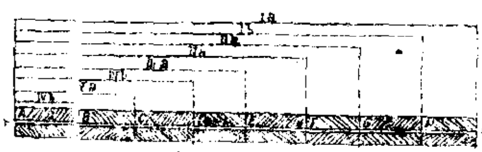
Thus the plot, when complete, will contain—

Selected	trees	of sub-class	I-*a*	from	A to K.
"	"	"	I-*b*	"	A to H.
"	"	"	II-*a*	"	A to G.
"	"	"	II-*b*	"	A to F.
"	"	"	III-*a*	"	A to E.
"	"	"	III-*b*	"	A to D.
"	"	"	IV-*a*	"	A to C.
"	"	"	IV-*b*	"	A to B.

The erection of substantial posts at A, K, and at one or more of the intermediate places would make it easy to locate the plot at any time. If a broad clearing, such as a 50′ or 100′ line, is used as a base line, the inner limit within which trees are not to be selected should be increased in the same proportion of about 2 to 1, *e. g.*, with a 100′ line the distance should be not less than 3 chains.

(ii) *A special ditch as base*—

The general idea is the same as with a road. No space need be left in the middle. The trees can be selected anywhere within ½ chain of the ditch.



As already remarked, the base line may be either straight or curved, whichever is more convenient. In the hills a rectangular or, may be, an irregular form of plot will probably be found most convenient. *The principle of compound areas remains the same,* and plots can be laid out in a similar manner by merely increasing the breadth and diminishing the length.

13. *Special plots for class V.*—Outside influences exert such a powerful effect on the trees in a forest in early youth, that it is doubtful if any precise information can be obtained by the periodical measurement of a few single trees of class V.

To find out the average time required to produce trees up to 1′ 6″ in girth, attention should rather be devoted to the young crop as a whole. For this purpose special plots are required. Out of 2,000 or more seedlings to the acre, as a rule, less than one per cent. will ever come to maturity. The particular 20 individuals cannot, however, be singled out and watched. It is impossible to tell one from another. But, starting with an area containing, of class V, only seedlings a year or two old, it should be possible to find out how long one per cent. require to attain a girth of 18″. To be on the safe side, let the observation be made for 10 per cent.

A small area of known size (say, 1 or 2 sq. chains) can be marked off. A good method of distinguishing the individuals under observation does not readily suggest itself. Two ways occur to the writer—

(*a*) Uprooting of all seedlings between 3″ and 18″ in girth at the base, thus leaving an interval of 15″ between the seedlings to be studied and the smallest saplings in class IV.

(*b*) Attachment of small metal labels by wire to all, or a specified number, of the seedlings under 3" in girth at the base.

Method (*a*) is simple, but it has the great objection of introducing a set of artificial conditions, so that it would be unsafe to depend solely on the data thus obtained. Method (*b*) is, therefore, to be preferred. Care must be taken to have *loose* wire loops, and to see that these are slackened every five years as required. The labels need not necessarily be numbered. The plot should be fenced to guard as much as possible against damage by animals.

By counting and measuring every five years, it should ultimately be possible to tell—

(i)	When 80 per cent. of the original number are	6" in girth	At breast height
(ii)	" 60 " " " "	9" "	
(iii)	" 40 " " " "	12" "	
(iv)	" 20 " " " "	15" "	
(v)	" 10 " " " "	18" "	

14. In coppice forests the same difficulty does not exist, except in the first few years of management. Where fellings have been started, the succession of coupes forms a series of young crops of known ages. The average girths of those percentages which will ultimately constitute the commercially mature crop can easily be ascertained.

The "Standards" can, of course, be treated in the manner already described.

15. *Selection of species to be measured.*—Although only the sâl has been referred to in particular in the foregoing notes, yet the latter are applicable, in a general sense, to any important species. Sâl is so much the most important tree in Oudh, both on account of its predominance in the forests and also because of the demand for its timber and fuel, that other species have been more or less left out in the cold. This should not be so. Even though, compared to that for sâl, the present demand for them may be small and the future prospects poor, still the determination of the rate of growth of some of the secondary species is of sufficient scientific interest to be worth the extra labour required for recording it.

The following species, other than sâl, might well be studied in Oudh :—

Asaina (*Terminalia tomentosa*).
Tikwi (*Adina cordfolia*).
Shisham (*Dalbergia Sisoo*).
Khair (*Acacia Catechu*).
Dhau (*Anogeissus latifolia*).

It is not suggested that separate plots for all these species should be established in all divisions, but that a general scheme for the whole circle would be worth drawing up. Neither would the numbers for sâl given in paragraph 9 be necessary. In many cases also sufficient Asaina and Tikwi might be found in the sâl

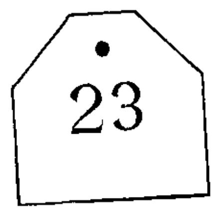
plots to obviate the need for separate plots. In this connection, however, care should be taken to choose only good and healthy trees of the secondary species in the sâl plots, and not to make-shift with any and every individual that happens to be handy.

PART II.

Up-keep and Measurement of Plots.

16. *General plan.*—The position of each selected tree should be recorded on a ground plan on a scale of 16″ to the mile, and the co-ordinates of each tree should be noted in the plot register. These co-ordinates will be two in number, *viz.*, the length of the offset on the base line, and the distance of the foot of the offset from the zero of the base line. An illustration of the usefulness of these records can easily be given. The old Dudua plots of 1880 and 1881 have not been attended to since 1892. A few months ago the writer examined the plots. Several numbers had disappeared, but the trees were identified from the map and register, which were prepared when the plots were first started. In the Bhira Sub-division there are similar old plots, but no further use can be made of them for want of such a map or register.

17. *Numbering of trees.*—Each species in a plot should have its own set of serial numbers. Opinions differ as to the best method of numbering the trees. Some officers prefer painting the figures on the bark. The writer prefers stamping the numbers on the tin plates, 4″ × 4″, and fixing these *loosely* to the trees with wire nails, 4″ long, driven in about $1\frac{1}{2}$″. In most divisions sets of iron numbers are used for logs. If not, a set could be made for a few rupees. They give a very permanent impression. The numbers should not be painted on the tins, and the tins should not be *firmly* fixed by nails driven right in. The old Dudua plots may again be referred to. The numbers were painted on thick iron plates, about 3″ × 4″, *firmly* fixed by two nails each, one above and one below, the nails being driven in right up to the heads. In the course of the past 20 years the paint has been obliterated in several cases, and many of the plates have been forced off altgether. Where one nail held fast, the plate has been almost completely buried in the wood, more or less transversely, by the growth of a swelling all round it. Besides spoiling the timber, such obstructions no doubt interfere with the growth of the trees, and so make the latter useless for measurement. The tins should be attended to, and renewed as required, at each periodical measurement.



18. *Rings on the trees.*—The periodical measurements must be made at the same place on the stem. This is ensured by painting a white ring round each tree, and by always placing the tape on it with the upper edges of the two coincident. The paint should be of good quality. English paint is best; bazaar stuff should be

avoided. If good material is used, the rings will not require renewal for ten to fifteen years at least. Care should be taken to force the brush right into the cracks in the bark. The outer projecting parts are the first to flake off. The inner parts remain longer. Lastly, the ring should not be painted over any excrescence or irregularity on the stem. This is of great importance. So long as the rings are easily within reach, it does not matter at all at what exact height they are from the ground. Sir D. Brandis, as far back as 1880, laid special stress on this point (see Appendix A).

Attention is invited to the above details, because they have not always been observed in the past. Inferior paint has sometimes been used; and, owing to a too rigid adherence to the 4′ 6″ rule, rings do sometimes run over swellings, or where the stems have sloping surfaces on one side. Over five per cent. of the measurements in Kheri are of little value for these reasons.

19. *Month of Measurement.*—Reference to Appendix A will show that Sir D. Brandis advocated the measurement of the trees twice a year—in December and April, respectively. This seems too great a refinement. The bark flakes off irregularly, and is elastic, *i.e.*, the layers can be pressed inwards to some extent if the tape is held at all tightly. For these reasons the records of annual measurements show great variations; one year the figure may be the same or a trifle less than it was the year before, and the following year there may be a large increase. It is doubtful if any information as to the season of growth can be obtained from ordinary girth-measurements. The time of measurement may well be left to the discretion of the Divisional Officer, so long as the successive measurements of the same plot are made at the same time each year. The different plots should be measured at different times, the Divisional Officer can then generally arrange to attend to them himself.

20. The second year's measurements are of use as a check on clerical mistakes in the record of those taken in the first year, but beyond this, as already explained, annual measurements are of no particular value. *Once in five to eight years is quite* sufficient for the measurement of girth and crown. The intervals, however, should be regular as far as possible. This can easily be managed except, perhaps, for the first few years, even when several plots are started simultaneously. With five years' intervals, and 15 plots in a division, the measurements could be arranged somewhat as follows:—

Year.	*Plot.*
1st	... 1 to 15, 1st measurement.
2nd	... 1 to 7, check measurement.
3rd	8 to 15 do.
4th	... ...
5th	1 to 5, 2nd measurement (after an interval of 4 years from 1st measurement).
6th	6 to 10 do. do. (do. 5 do. do.).
7th	... 11 to 15 do. do. (do. 6 do. do.).
8th	... ...
9th	... ...
10th	... 1 to 5, 3rd measurement (after an interval of 5 years from 2nd measurement).
11th	... 6 to 10 do. do. (do. 5 do. do.).
12th	... 11 to 15 do. do. (do. 5 do. do.).
13th	... ...

If all plots are not started in the same year, the arrangement can be simpler, with regular intervals from the commencement. Whatever the plan may be, it should be drawn up and put on record.

21. *Crown measurements.*—The rate of growth in girth in the different classes can only be of use in gauging the productive capacities of different localities, when the trees under measurement grow under approximately similar conditions as to crown development in the plots under comparison. Recording the total sectional area per acre of all stems, good and bad, would be of little use, as the classes could not be separately dealt with in any useful manner; half-a-dozen poles of a foot each would count as equal to one tree of 6 feet, although the latter might cover as much ground as two dozen of the former. The best plan that suggests itself is to base the comparison on the sectional area of the crowns. The midday shadows can easily be measured. A step further would be to take the depth of the crowns into account; but this would be impracticable on a large scale.

The trees should be classified as follows:—

(i) Dominant (= D).

(ii) Dominated ($\frac{d}{1}$, $\frac{d}{2}$, d).

$\frac{d}{1}$ = overtopped by a single tree on one side only.

$\frac{d}{2}$ = overtopped half-way round.

d = overtopped all round.

The crown measurements should be repeated, and the classification be revised as often as the girth-measurements are taken.

22. *Register of plots.*—Sample plot-registers are not often referred to, except on the rare occasions when a working-plan is in course of preparation. This may be partly due to trees of all sizes and species being mixed up together according as the serial numbers happen to run. The growth of trees in the same class cannot be compared at a glance. A better plan is to have separate pages for the different species and to arrange the trees according to size. This can be done, in the first instance, down to single inches, without much trouble. Decimals need not be considered in this arrangement. The trees can also be arranged in groups with a range of 9 inches, corresponding to the sub-classes already suggested. Between each group as many lines can be left blank as there are trees in the next smaller group. When any measurement subsequent to the first shows that a tree has passed into the next higher sub-class, from that time forward its measurements should be recorded in the latter. For example, suppose the measurements of a tree are—

1st year	4′ 3″
6th ,, ...	4′ 7·5″
11th ,, ...	5′ 0″
16th ,, ...	5′ 4·5″

To treat such a tree in the register as being always in class III would not be correct. The exact year when it passed into class

II does not matter; but, for the first six years the tree should be treated as belonging to class III and afterwards as belonging to class II. Some of the trees in the old Dudua plot have passed through a whole class of 18 inches since 1880.

23. One little detail may be mentioned, only to be avoided, *viz.*, the survival, in some instances, of the "parts" of an inch. Decimals are much simpler.

24. Instead of having separate books for different ranges, all plots in a division should be recorded in one book; better still, one for a whole circle. When the initial measurements and plans are complete, they could be printed, with blank columns for later years, and bound up with the working-plan for the forest to which they refer. This would be well worth the little extra expense involved.

PART III.

SAMPLE PLOT RULES.

25. (A)—*Trees over* 18 *inches in girth in high Forest.*

Rules.	Selection and Preparation of Plots.	Paragraphs.
1	A plot is to be chosen for each type of forest.	
2	The size of a plot is to depend on the number of trees to be measured; not the reverse. All girth-classes need not necessarily be spread over an equal area.	11.
3	Only selected trees are to be measured, vigorous and healthy ones being chosen. As a rule, the following kinds of trees are not to be selected:— (i) Isolated ones with large crowns. (ii) Short and crooked ones. (iii) Coppice shoots.	1 to 7.
4	Plots are required for each of the following species:— Sâl ... In all divisions. Asaina ... ... Tikwi ... Shisham ... Khair ... Dhau ... (Asaina to Dhau:) Not required in all divisions; the Conservator to decide. The plots need not be in separate places, if suitable trees of more than one species are available in one place.	15.
5	The number of trees selected in each plot is not to be less than the following, without the special sanction of the Conservator:—	8 and 9.

Class.	Sub-Class.	Limits.	No. of Trees.	REMARKS.
		over 7′ 6″	?	Full numbers for the principal species; proportionately less for other species.
I ...	a	6′ 9″ to 7′ 6″	5	
	b	6′ 0″ ,, 6′ 9″	5	
II ...	a	5′ 3″ ,, 6′ 0″	10	
	b	4′ 6″ ,, 5′ 3″	10	
III ...	a	3′ 9″ ,, 4′ 6″	12	
	b	3′ 0″ ,, 3′ 9″	12	
IV ...	a	2′ 3″ ,, 3′ 0″	12	
	b	1′ 6″ ,, 2′ 3″	12	

PART III.

SAMPLE PLOT RULES.

25 (A)—*Trees over* 18 *inches in girth in high Forest.*

Rules.	Selection and Preparation of Plots.	Paragraphs.
6 ...	The selected trees are to be personally inspected by the Divisional Officer before being accepted.	
7 ...	The linear form of plot is to be adopted, unless any other form is preferable in special cases, to be sanctioned by the Conservator.	12
8 ...	Narrow roads (15′ to 10′) as base lines are preferable to broad ones (15′ to 100′), as the trees can be selected nearer to them than with the latter.	12
9 ...	Base lines, other than roads, are to be ditched (2′ × 2′). In all cases *the terminals are to be marked* by good *substantial posts*, dressed and tarred.	12
10 ...	Plots, other than linear ones, are to be ditched all round.	
11 ...	With a road or fire-line as base line, the trees are not to be chosen within a distance equal to twice the width of the clearing, or more than ½ chain greater than this distance, measured from the edge of the road or line. With a special base line the trees are all to be chosen within ½ chain thereof.	12
12 ...	The position of each tree is to be recorded— (i) on a map on a scale of not less than 16″ to the mile ; (ii) in a register.	16
13 ...	The trees are to be serially numbered (each species in a separate series) with tins (4″ × 4″), loosely fixed by 4″ wire nails driven in about 1¼″. The numbers are to be stamped (not painted) on the tins.	17
14 ...	When *painting rings* on the trees the following details are to be observed :— (*a*) The rings are to be at right angles to the axes of the trees. (*b*) The rings are to be more or less at breast-height from the ground, but irregularities or excrescences must be scrupulously avoided. (*c*) A good brand of zinc oxide is to be used, not cheap bazaar material.	18
15 ...	The rings and tins are to be renewed as often as required. With good paint, once in 10 to 15 years will generally be enough for the former.	18

PART III.

SAMPLE PLOT RULES.

25 *(A)—Trees over 18 inches in girth in high Forest.*

Rules.	Selection and Preparation of Plots.	Paragraphs.
	Measurements.	
16 ...	Girths and crowns are to be measured in the 1st, 2nd, and every 5th year.	20
17 ...	So long as no change is subsequently made, the month of measurement is immaterial, the work being finished a clear month before the end of the working season.	19
18 ...	All girth-measurements are to be made with the upper edge of the tape touching the upper edges of the rings.	18
19 ...	The tension on the tape is to be only just sufficient to hold the latter in position.	
20 ...	All the measurements are to be taken by a gazetted officer (preferably by the Divisional Officer himself).	19
21 ...	The trees are to be classified as follows :— (i) Dominant (= D in register). (ii) Dominated $\left(\frac{d}{1}, \frac{d}{2}, \text{ d in register}\right)$. $\frac{d}{1}$ = overtopped by a single tree on one side only. $\frac{d}{2}$ = overtopped half-way round. d = overtopped all round.	21
22 ...	The trees are to be arranged in the register according to girths, down to whole inches, 10 to 15 lines being left blank between consecutive sub-classes.	22
23 ...	When a periodical measurement shows that a tree has passed into the next sub-class, that measurement is to be recorded in two places in the register— (1) in its place in continuation of preceding figures; (2) by transfer of the tree to the bottom of the next higher sub-class.	22
24 ...	"Parts" of an inch are not to be used ; only decimals	22
25 ...	The register is to be kept in the following form :—	22

Species.	Serial No.	Position.		On........th. of........19 .				On........th. of........19 .				On........th. of........19 .			
		Base.	Offset.	Classification.	Girth. ′ ″	Crown. sq. ft.	Remarks.	Classification.	Girth. ′ ″	Crown sq. ft.	Remarks	Classification.	Girth. ′ ″	Crown. sq. ft.	Remarks

Rules.	Selection and Preparation of Plots.	Paragraphs.
	B.—*Class V—plots.*	
26 ...	A known area (1 to 2 sq. ch.) is to be permanently demarcated by a ditch, if necessary ; the plot should be fenced.	13
27 ...	All, or a specified number of the seedlings under 3" in girth at the base are to be labelled with small metal plates loosely attached by wire. Coppice shoots are not to be labelled.	13
28 ...	The seedlings are to be counted and measured every five years until 10 per cent. have attained to a girth of 18" at breast-height.	13
	C.—*Coppice Forests.*	
29 ...	Enumeration surveys are to be made in a series of coupes of known age and averages to be taken from the best 75 per cent. of the crops.	14
30 ...	Standards are to be treated as in high forest ...	14
	(To be continued.)	

F. A. LEETE,
Deputy Conservator of Forests.

V.—SHIKAR AND TRAVEL.

Only a Cub.

That there was tigress in the jungles somewhere near my camp I knew, but she could not be persuaded to kill any of the baits that I had had tied up for her. Her tracks one morning showed that she had gone along a nullah not ten yards from one of the tied-up bullocks, but she had not touched it, and it seemed as if she fed on game only, as no damage to any of the cattle herds in the neighbourhood had been reported. I had quite given up all hope of getting a shot at her, and had, on my last day at the village of A., arranged for coolies to be collected to beat through a hill near my camp which was a sure find for bear (if only they could be persuaded to break, which was not aways the case, as

there were so many caves in the hillside), when word was brought that a kill had taken place in a nullah between the bear's hill and my camp. On going to inspect the place where this had happened, I found that the carcase had only been dragged a short way from the nullah into the jungle along its banks, and but little of it had been eaten. The tracks showed that there was a cub with the tigress—a fact of which I before had not been aware, and the tracks further showed that after their meal the two animals had separated, the cub remaining in the jungle near by, while its mother had returned by the way she had come to the kill. For about two miles we followed her tracks which led us away from the nullah, and then they struck a small village path and we lost them. This was disappointing; but there was the chance that the tigress had gone round by some other way to join its cub, so I gave up all thought of having a bear beat, and instead made arrangements to beat along the foot of the hill on both sides of the nullah for the cub, and, if possible, for its mother too. The spot that I selected for my station was on the side of a small dried-up stream (a tributary in the rainy season of the nullah where the kill had taken place); all around me was grass jungle with scattered trees, and about 400 yards to my left was the bear's hill. Directly behind me, about 600 yards away, was another hill, for which it was anticipated the tigers would make on being disturbed. It was necessary in such a grass jungle to have a large number of stops, for although the grass was high and thick it was not matted, and a tiger could get through it easily anywhere, so I selected forty of the least stupid-looking from among the coolies assembled and placed twenty on each side of me, those on the left extending up to the foot of the hill. While laying the stops on the left my *shikari* came face to face with the tigress who was sleeping alone—the cub not being with her, at least my *shikari* did not see it—in a small depression at the foot of the hill. Fortunately, on being disturbed, she bounded off into the forest through which the beaters were to pass.

I had waited about two hours in my *machan* before I heard the welcome sound of the beaters advancing, and as I lifted up and cocked my rifle, I scared a covey of bush quail, that had allowed me to watch them feeding among the sâl leaves below me, and they scurried away across the dry stream and into the grass on my right. Ten minutes later I heard the sound of an animal coming towards me on my right; at first I thought it must be the tigress as it made so much noise among the dry leaves in the nullah, but it was only a four-horned antelope-buck that stood and looked at me and offered a most tempting shot at twenty yards which, of course, I did not take. Then after another wait of 10 or 15 minutes, the tiger-cub appeared. It came towards me across the bed of the nullah at a good rate, and I fired, when it was almost below me, between the shoulders, killing it at once.

All this time I was not aware that the tigress was in the beat, as my *shikari* did not tell me till afterwards that he had almost stumbled upon her as he was laying out the stops, and I was consequently very pleased to hear a low growl that could only come from her, soon after I had shot the cub. I heard her moving about the bed of the nullah, apparently coming and re-crossing it, and though I imagine she saw me, I never caught a glimpse of her, until the beaters were nearly up to her, and then she sprang across the nullah and through the grass to my left offering me two snap shots, both of which were unfortunately misses. They were both difficult shots; the first among the trees, and as there was a bend in the nullah when she crossed it, I could not get a clear view of her; and the second, in the long grass. The latter I ought to have made fairly sure of, but as I was on the point of firing I noticed that one of the stops, who was in a low tree to my left and rather below me, was almost in the line of fire, and I had to hold my fire until the tigress got well clear of this line. This delay put me off my shot, and, in all probability, accounted for my miss. After the beaters had come up, and I had searched carefully to see if either of my shots at the tigress had taken effect, I decided on another beat, through the low hill that I have already said was situated behind where I had been stationed. The tigress's track lay straight in this direction, and it appeared as if she must be lying up there; but the beat, which was a miserable, uncomfortable one, as a drizzling rain set in while the stops were being placed, proved blank, and we found that the tigress had made for this hill; but instead of ascending it, she had skirted along its foot and gone thence to some thick jungle and hills to the south-west. It was too late then to think of trying to hunt her up there, for I had 8 miles to go to my next camp and the sun was then very near the horizon, so I had to be contented with the cub I had bagged, and leave the mother for some future occasion.

AMTONG, *Raipur, C.P.*

LONG TOM.

VI.—EXTRACTS, NOTES AND QUERIES.

A Visit to Dr. Schlich's Forests at Mirwart.

By Colonel F. Bailey.

The following notes, made by me during a visit paid in the spring of 1898 to Dr. Schlich's estate of Mirwart, in the Belgian Ardennes, may, I hope, interest readers of the *Transactions*. Mirwart lies on the main line of railway running between Brussels and Metz. Much of this hilly region is still under forest, of which 2,844 acres belong to the estate. The woods, at an elevation ranging from 900 to 1,300 feet above sea-level, occupy a series of undulating hills with rounded tops, which are frequently extended

into plateaux. The rock is clay slate. The soil is for the most part a somewhat stiff loam, but clay is found in some places; the soil is shallow, rocky or stony on southern aspects, but elsewhere it is of good depth. The mean annual rainfall is from 35 to 40 inches.

The growing stock is constituted as follows:—Sixty acres of oak coppice, which is to undergo conversion into high forest; 100 acres of Scots pine, from fifteen to thirty years old; and the remainder, 2,684 acres, carrying crops of beech and oak, generally mixed with a small proportion of hornbeam, sycamore and Norway maple. About 2,000 acres of the last-named area have been under-planted with spruce, except in the most choice localities, where either acorns have been dibbled in or one-year old oak seedlings have been planted to the number of 8,000 to the acre.

Grand Campe.

A forest of beech, oak, and other hardwood trees of all ages, the remnant of a forest formerly worked on the "Selection" system. The stock had been very irregular; and though in a few places it was sufficient, the crop was for the most part far too thin, yielding an annual increment of perhaps not more than 15 to 20 cubic feet per acre, instead of 100 cubic feet, as it should have done. It was desired to remedy this state of things, and to obtain a full increment from the soil by under-planting with spruce, to be grown for pit-props. But notwithstanding the general deficiency in the stock, some thinning had to be done in places in order to permit the introduction of the spruce; and a secondary object of this treatment was to realise the value of the trees to be thus taken out.

The general rule followed in thinning was to remove all mature trees, with such as were diseased, injured, or misshapen, and would not improve sufficiently to warrant their being left standing throughout the rotation of the spruce, that is, for a period of forty years. In the denser parts, however, which occupied but a small proportion of the area, under-planting was not contemplated; and here fewer trees were taken out, the object being to leave the cover as complete as possible.

After this thinning, the greater part of the area carried a light crop of from 40 or 60 hardwoods to the acre; and these were carefully pruned to a height of about 16 feet from the ground, all branches under 3 inches in diameter being cut off close to the stem; the spruce were then introduced, 2-year—1-year plants being pitted at 4 feet 3 inch intervals (2,400 to the acre).

An area of 1,700 acres on the estate has now (in 1900) been treated on this principle. The oldest of these spruce plantations, 450 acres in extent, and planted during the season of 1893-94, has already attained a height of 12 feet, and, growing vigorously, presents a remarkably healthy appearance. After the lapse of forty years the spruce will be cut for pit-props, and the remaining

hardwood standards will be deält with as may then appear expedient.

In order to carry out the fellings of spruce, the forest, which will bear an even-aged under-crop of that species, will be divided into four blocks; and, to avoid risk of damage by insects, through felling in successive years on adjacent compartments, the cuttings will be arranged as follows:—

First Year in Block A,	Third Year in Block C,
Second Year in Block B,	Fourth Year in Block D;

after which they will recommence in the Block A, so that there will be a clear interval of four years between two successive cuttings in any block.

Where the young spruce may be interfered with by coppice shoots already existing, or springing up as a result of the thinning, they will have to be protected by cutting back the coppice. In similar woods, where the soil was not considered good enough for spruce, the White (Weymouth) pine has been substituted for it.

Five-Hundred Acre Forest of Hardwoods.

Here, though the stock was deficient, and the annual increment much below what it should have been, the crop was far better than that found in Grand Campe, but the proportion of oak was too small. The treatment laid down was to pick out the thinner parts, where the scantiness of the crop was not due to poverty of soil, and to extend them by thinnings, made with a view to the planting of one-year old oak seedlings to the number of 8,000 to the acre, or about 2 feet 4 inches apart. It had originally been intended to introduce the oak by dibbling in acorns at intervals of 12 to 15 inches, but this intention had to be abandoned owing to the depredations committed by mice. After about ten years, when the young oaks have had time to establish themselves, the denser parts of the wood will be regenerated for beech; and the result will be a mixed forest of oak and beech, arranged in groups, the oak being at least ten years older than the beech.

At Mirwart it is not advisable to leave isolated beech standards, as they are liable to injury, inducing disease, occasioned by the direct impact of the sun's rays on their exposed stems, especially during severe frost. Beech standards also expand their crowns too widely, and grow into trees of small value.

Oak Coppice on a Southern Slope.

A worn-out coppice. The open space has been planted up with oak seedlings, which were destined to grow into standards, and to yield additional and vigorous stools for coppice. In places where the soil is very poor, Scots pine had been planted between the stools.

Ribelle Rose.

A very irregular beech-wood, consisting chiefly of poles with some trees of larger size, and a few oaks; also some naturally sown beech seedlings, in patches up to ten years old.

The treatment was to be as follows, *viz.*:—

(*a*) To widen openings over natural growth of beech, and thus permit its extension.

(*b*) Where the cover was light enough, and the natural growth of beech insufficient or absent, to under-plant with spruce.

(*c*) To plant larches here and there amongst the natural growth of beech, and amongst the young spruce in the more open parts.

(*d*) To defer for a time the regeneration of the denser parts of the crop.

The result of this treatment will be a mixed crop of beech and spruce, arranged in groups, with some larch scattered throughout them.

Fange d'Estang.

Swampy ground, with a thin young coppice of birch, oak and other species. The ground had been planted up with spruce at 3 feet 3 inch intervals; the plants were looking yellow, and many of them were making but little progress, especially in the wetter places. But on the little bank made by soil thrown out of the ditches, they were doing well. A good plan might have been to make small ditches and ridges at 8 or 10 feet apart, and to plant spruce on the ridges. The intervals between the lines thus formed might have been stocked with birch, which, however, grows spontaneously in places.

A little farther on we entered a thin forest of beech poles under-planted with spruce, a few oaks being seen in the thinner parts.

La Hure du Chapeau.

A forest situated on an open, sunny, southern slope, the soil being thin, dry and stony, with a covering of short grass and herbs from 6 to 12 inches high. The ground was to be sown with Scots pine, in accordance with an old local practice, as follows:—

The denser parts of the herbage to be burned off, and the seed to be sown broadcast without further preparation of the soil. Shallow trenches, from 3 to 4 inches deep, to be then dug with pick and shovel at 6½ feet intervals, the sods and soil being scattered between the trenches. This soil, together with that knocked out of the sods, falling through the herbage, was to afford a light covering to the seed.

The estimated cost of this method of sowing is 10*s.* for the seed and 32*s.* for the work, in all £2-2*s.* per acre.

Fosse Orban.

Here thinnings of undesirable trees had been made, and a light crop, consisting principally of oak, remained; this was to be

under-planted with spruce, the oaks being pruned up to a height of about 16 feet. The shade was for the most part too heavy for a crop of Scots pine, but this tree has since been sown on the more open and drier portions of the area.

Sapins de Biolin—30 *Acres*.

A crop of Scots pine, about twenty-four years old, raised by broadcast sowing.

The *first thinning* had been made at the age of nineteen years, when dead, injured, misshapen, and suppressed trees only were taken. It realised about 4*s*. an acre net. A *second thinning* had been made at the age of twenty-one years; it was similar in character, and realised about 16*s*. an acre net. A *third thinning* had been made (at the age of twenty-four years). It resembled the above, but a few additional stems were removed from patches which appeared too dense. It realised £2 an acre net. The crop remaining after the third thinning consisted of about eighteen hundred stems to the acre, or about half the number that had been previously cut out. The height of the dominant trees was 39 feet, their diameter being 5 inches at $4\frac{1}{2}$ feet above the ground. Dead branches had been knocked off up to a height of 8 feet. The ground was covered with moss, unmixed with grass, indicating that the cover was not too open. A *fourth thinning*, similar to the third, has since been made at the age of twenty-seven years, and has realised £4 an acre net. A *fifth thinning* will be made at the age of thirty years. It will be somewhat heavier than those preceding it, in order to allow the remaining trees to expand more rapidly in girth. It is expected to yield £8 an acre net. The crop on the ground after this thinning will be about six hundred trees to the acre.

If it be then decided to clean-fell for pit-wood at the age of forty years, and if it be evident that the desired diameter will be attained at that age, the crop may be left alone; but, if necessary, a *sixth thinning* will be made between the thirty-sixth and the thirty-eighth years, in order to promote the further development in diameter of the final crop. This crop, together with the produce of the sixth thinning, if made, is expected to realise from £55 to £65, or, say, £60 an acre net. After it has been removed, the ground will be *re-sown* with Scots pine.

The financial returns will probably work out somewhat as follows, *viz*:—

			£	s.	
First thinning at	19	years	0	4	*realised.*
Second "	21	"	0	16	"
Third "	24	"	2	0	"
Fourth "	27	"	4	0	"
Fifth "	30	"	8	0	*expected.*
Final crop at	40	"	60	0	"
		Total	75	0	an acre net.

This represents a net sale-price equivalent to £1-17s.-6d. per acre per annum.

The produce of the Mirwart woods is sold either by public auction, by private contract, or by tender, the last being the more usual practice. The crops are all sold standing, the purchaser felling and converting the trees and removing the timber. Scots pine poles, from twenty to thirty years old, sold as pit-wood, realise about $3\frac{1}{2}d.$ per ($\frac{1}{4}$-girth) cubic foot net; at thirty-five to forty years old the net price rises from 4*d.* to $4\frac{1}{2}d.$; at fifty years old to 5*d.*; and so on. Old Scots pine fetches a net price of 7*d.* or 8*d.*; beech realises from 7*d.* to 10.; oak, on an average, 1s. 3*d.* per ($\frac{1}{4}$-girth) cubic foot net.

If at about the thirty-fifth year it should be decided to let the wood stand to produce timber of larger size, instead of cutting at the age of forty years for pit-wood, a thinning will then be made sufficient to permit the introduction of an under-crop of beech; and further thinnings will subsequently be made, from time to time, to enable the beech to develop. The produce of these thinnings will be sold as pit-wood, and the best of the Scots pine trees will be left as standards until they attain their most profitable dimensions. The final crop will, in the end, probably consist of pure beech.

Had the crop of Sapins de Biolin been composed of spruce instead of Scots pine, the rotation of forty years for pit-wood might have been adhered to; but the first thinning would probably not have been required until about the twenty-fifth year. Even at that age the number of dead, dying, and suppressed trees would probably have been small, and it might have been found necessary to remove a portion of the healthy stems in order to afford more growing space for those left upon the ground. Thinnings might have been necessary at short intervals between the twenty-fifth and the thirty-second years, after which a comparatively heavy thinning would have been made, in order to allow the stems of the final crop to put on girth. At the age of forty years the crop per acre might have been expected to consist of from 800 to 900 trees (as compared with 600 in the case of Scots pine), these trees being about 55 feet high and having a girth at breast-height of about 18 inches. The volume of such a crop would be about 30 per cent. higher than the crop of Scots pine, and the yield per acre per annum might approach 150 cubic feet. On the stock being removed, it would probably have been renewed by planting spruce at 4 feet intervals.

A Hill-Side,

from which a crop of Scots pine, consisting of 600 trees to the acre, and forty years old, had been cut for pit-wood in 1892. The ground had then been planted up with Scots pine, spruce, and White (Weymouth) pine. The treatment contemplated was to utilise all thinnings made up to the age of forty years as pit-wood. The greater part of the Scots pine would be taken out

during these thinnings, and the remainder of the crop, mostly spruce and White pine, would be allowed to grow on into high forest. At the end of the rotation, the area might be re-stocked with spruce by the method of natural regeneration.

Valuation Survey.

A matter well worth recording in connection with these forests is the manner in which Dr. Schlich made, a few years ago, a rapid valuation survey of them. He spent three days in passing through all the blocks which make up his total area of 2,844 acres. Once within the woods, he commenced by marking off upon the ground an area of one-tenth of an acre. On this small plot he estimated the value of every tree; he then walked on, at an even pace, for exactly ten minutes by the watch, when he halted, marked off a second area of one-tenth of an acre, and likewise estimated the value of every tree upon it. He proceeded in this manner throughout the whole of the three days; and adopting the measured plots as sample areas, he calculated from them the money value of the stock standing on the various blocks of the forest and on the whole property.

He has since been able to check the correctness of a portion of his work, and the following figures may be taken as fairly representing the degree of accuracy he attained. A block called Les Loches was estimated to carry stock worth £11,960. Having cut and sold timber from this block to the net value of £8,400, he carefully measured what was left, and found it worth £3,960. These two values added together amount to £12,360, only £400, or $3\frac{1}{2}$ per cent., in excess of his valuation. On the whole, so far as he has data for forming an opinion, Dr. Schlich believes that his other estimates will turn out to be from 4 to 5 per cent. below the actual values, and will thus leave a suitable margin to meet unforeseen contingencies. Considering the very irregular nature of the crop, which changed in character every few yards, the results attained by his rapid survey are truly astonishing. They testify in a remarkable manner to his experience and skill in estimating.—*Transactions of the Royal Scottish Arboricultural Society.*

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Rotation and Possibility in Selection Forests.

BY W. SCHLICH, C.I.E., Ph. D.*

IN the March Number of 1901 you brought out an article by Mr. Gleadow on "Rotation and Possibility in Selection Forests." That article had been inspired by one of M. Broilliard's, headed "Une Catachrèse Forestière," published in the *Revue des Eaux et Forêts* of the 1st October, 1900. Allow me to invite your attention to the *Revue des Eaux et Forêts* of the 1st January, 1901, where you will find a short article by me on the same subject.

Mr. Gleadow seems to be affected by the term rotation (revolution) somewhat in the same way as the conventional Spanish bull by a piece of red cloth, and yet he uses that abused '*thing*' every day of his life, though he may not be conscious of it. Unfortunately, I am at this moment overburdened with work, or I should have gone fully into the details of the matter. May I ask you to publish the accompanying translation of my little article, and I promise you that I shall return to the subject as soon as I can find the necessary time.

In the meantime I beg to point out that Mr. Gleadow is wide of the mark when he says that Judeich, "the Great German Professor," is responsible for the French considering the selection method as a barbarous method; or, again, when he says:—"Judeich denies to selection the status of a method at all, since its possibility was incapable of being prescribed. But then he was thinking of nothing but *volume*." If this is what Mr. Gleadow has found in Judeich's writings, then he has, indeed, wasted his time.

As a matter of fact, Judeich regulates the yield, in the first place, by area, and as regards the selection method, he says on page 407 of the 5th edition of his *Forsteinrichtung* the following: –

"According to my view, in the case of the selection forest, the sylvicultural treatment and the considerations for a prospective

* See page 121 and 230 of this volume.

orderly grouping of the cuttings must decidedly take precedence of the cutting of a fixed yield; hence the latter can only serve as an entirely approximate estimate."—*Cooper's Hill, 24th March,* 1901.

Une Catachrèse Forestière.

Under this title M. Broilliard publishes an article in the October Number of the *Revue*. In this article, M. Broilliard recommends once more the determination of the yield by area in the case of selection forests, and he tries to demonstrate the uselessness, or even the mischief of using the term "rotation." As regards the first point, I am at one with M. Broilliard. My experience extending over more than forty years has proved to me that whenever the yield is determined by volume, one of the following two things occur:—

(1) Conscientious and prudent foresters always estimate the yield below the proper amount, from fear of estimating it too high.

(2) Foresters, with a more elastic conscience, generally estimate the yield too high.

In either case loss is the result. Hence the only means of assuring a proper management in the case of selection forests is to regulate the yield according to area.

As regards the second point, it seems to me that M. Broilliard goes too far. No doubt the several annual coupes differ more or less in material, but the object to be arrived at in each case should be to lead them over into a normal condition, so as to insure, as far as possible, an equal and sustained yield. Hence the cuttings in the understocked parts should be light, and heavy in the overstocked parts. But this is not all. Supposing we have to do with a forest in which each annual cutting area possesses a most regular crop, no doubt the question arises—"How much should be marked for cutting?" That quantity must, in the first instance, be decided by the approved rules of sylviculture. They tell the forester to cut—

(1) all mature trees which do no longer show signs of a sufficient increment;

(2) all sick or badly-shaped trees, if other circumstances permit their removal;

(3) such young trees which require removal from cultural considerations.

Then, it may happen that, following the above rules, cuttings would be so heavy that, on returning to the same cutting area after a number of years, there would be little or nothing to cut. M. Broilliard himself, in citing as an example the communal forest

of Pont-á-Mousson, has shown how little desirable this is. To avoid such inconveniences, the forester must construct for himself the law never to cut, at any one time, more than a certain proportion of the growing stock.

Let us take, for instance, a coppice with standards forest, and say, "Cut one out of every four standards at each going round." What does this mean? Assuming that the coppice is cut every thirty years, the four standards will be removed in $4 \times 30 = 120$ years, and four new standards take their place. Here you have a rotation of 120 years, or, if you add the age of the coppice, 150 years. *This is the calculation which passes through the brain of the forester, who marks the trees, whether he be conscious of it or not.* In marking one standard out of four, he determines the rotation under which the standards are treated, that is to say, the number of years during which the trees, growing at a certain moment, are replaced by a new crop. It is exactly the same thing in the case of a selection forest. On an average the growing stock is replaced by a new growing stock in the course of a certain number of years, which is the rotation; the length of it depends on the quantity which is cut on each return to the same area.

Why then this aversion to the term rotation? It seems to me such an innocent one.

In France, foresters have commenced war against the application of mathematics in the management of forests. After all what is the object of working-plans (*aménagement*) if it is not the proper and systematic application of sylviculture? A management which is not based on this fundamental principle, cannot be correct. At the same time the management cannot realise its object without the help of simple mathematical rules in every case when the object is to obtain a sustained and approximately equal yield. If foresters are afraid of the application of mathematics to the management, it is due to a faulty application, and not to an error of principle. Mathematics must be the servant, and not the mistress of sylviculture.

Proportionate Fellings in Selection Areas.

By O. C.

THERE is an ancient flavour about M. Broilliard's suggestion as transmitted by Mr. Gleadow to regulate selection fellings by a removal of a fixed proportion of the crop over the whole of the felling area. In the dim past, I seem to remember a prescription of 1 in 3 stems in "sál" forests; in the vivid present, I find it enforced in teak forests; in the hopeful future, I trust to see it placed in the list of obsolete makeshifts by means of which the Indian forester was at one time compelled to check the carelessness of ignorant subordinates, to control the revenue-hunting Divisional

Officer, and to prevent mechanically the too rapid uncovering of the soil in forests, where protection from fire was not assured. We are now in a position not to seek for information by laborious experiment, but to criticise the results of this method in Indian forests.

It is true that with us the term "age class" is a fiction; that in selection fellings trees are cut of all ages and even of all sizes; but the main crop still consists of stems which by attaining a certain girth-measurement have also, so far as our information has guided us, attained commercial maturity. It is this portion of the crop that we have for the last twenty-five years and more been accustomed to remove subject to the check of proportionate fellings, and it is understood that it is also this portion of the crop which is specially treated of in Mr. Gleadow's paper.

A forest must, however, be in a bad way when the forester is obliged to retain a large number of stems after the period of their most profitable utilisation has passed; especially in India, where trees of the lower girth classes should provide all the seed-bearers and all the canopy required. For such treatment must result not only in a present loss of interest, but also in retarding the birth of a new generation with the consequent drawbacks in the future.

Under this system the forester has indeed the power to fell individuals or groups of trees, provided the fixed proportion is not succeeded; but if his forest is in proper order he should in theory be able to remove each stem as it enters a prescribed girth-class in the certainty that reproduction of the species will at once take place in the blank created. It was this theory, though not set forth in these terms, which Captain Wood, Conservator of Forests, who commenced his forest service in the early sixties, endeavoured even up to his retirement to set before the department. But he failed to shake off the incubus of proportionate fellings, because of his failure to utilise the unsound mature stock. His method of extraction necessitated good quality in the yield of his forest, and had the restriction been removed, every sound tree would have been felled. With a change in the method of extraction, with the utilisation of unsound stems, proportionate fellings ceased, and in the crop of the future will happily be vindicated Captain Wood's assertion that we were utilising only one-third of our actual yield.

There are no long chairs in this circle, but from the limited comfort of a folding stool, I hazard the humble opinion that *in India* the system of proportionate fellings is a refuge for the destitute, a poor makeshift for the individual attention each stem should receive before its removal from selection areas. Further, that it involves a serious loss of revenue, and that it violates those natural laws by the observance of which alone we can induce the prompt natural regeneration of the most valuable species.

Checks with possibility by Area.

BY A. G. HOBART-HAMPDEN.

MR. GLEADOW'S interesting résumé of M. Broilliard's article on "Rotation and Possibility in Selection Forests" draws attention to a most important point. Few will now stand up for Possibility by volume, but its alternative, Possibility by area, is inadmissible without something in the nature of a check to prevent excessive felling. For the regular forests of France, where the stock is complete throughout, M. Broilliard advocates a *proportionate* felling, that is, the felling of some proportion of the number of trees existing in the crop. But for our own irregular forests, which are in some places too thin, and in others perhaps too thick, it appears to me the form of check should be the other way round, that is, that a certain number of trees should be reserved per acre to serve as an irreducible minimum of safety. The usual Improvement Felling Working Plan merely provides that the felling shall be done on sylvicultural principles. The position has been taken up that the old ruined forests we have taken over are encumbered by a mass of very inferior material, which, when it suppresses better material, must be cleared away as rapidly as possible. Now if you can bring figures to prove that it is economically best to cut away at once all this superincumbent material, put the resulting large revenue into the Bank, and wait through a generation till the fine young crop which has thus been relieved is ready for the axe, then there is nothing to be said; the operation is sound. But if this cannot be shown, and a more or less sustained yield is insisted on, then I think that improvement fellings by area with no guarantee against excessive felling cannot safely be adopted. By "excessive felling" it will be seen that I only mean excessive financially, not sylviculturally.

The protection afforded to the damaged forests we took over was quickly followed by a grand crop of seedlings beneath the badly-grown upper stage, and in accordance with working-plan prescriptions, a very large proportion of this upper stage has been removed in the improvement fellings. Thus we now often find ourselves face to face with the question—"Where shall we get our revenue during the next rotation?" "From thinnings among clumps of poles and from such of the old upper stage as it was sylviculturally impossible to touch in the first felling" it will be answered, but there will certainly, in most plains sâl forests, be very little large material (that is, the material which brings in the bulk of the revenue) available, and it is at least very doubtful if the revenue of the next generation will come up to that of the past. However that may be, it is most necessary to avoid any such doubt in the future, and to provide some check on the possibility by area in the new working-plans made to replace the first improvement felling plans, now everywhere drawing to a close.

Our check may depend to some extent on the mode of treatment to be employed during the next rotation, but if we take a hypothetical case, which might well occur, and think out a form of check for that, it will be sufficient to indicate the kind of thing I mean.

Imagine, then, a sâl forest worked in the past under the usual system of improvement fellings, which is shortly to be brought under a system of selection, consisting in the removal of all stems over 6 feet girth with a felling rotation of thirty years. Past fellings may be supposed to have been heavy, and the result to have been such that to rely on the 6 feet (say, I. class) trees only for revenue, will mean a large drop in revenue. It is proposed therefore to continue to improve the crop of the other classes by subsidiary felling (*i.e.*, in fact improvement fellings). Now there will lie the risk. How are we to know that the subsidiary fellings will not remove so much II class material that at the end of the first felling rotation there will not be as many first class trees to fell in the second rotation as there were before? The only answer, it seems to me, is that we must *mark in reserve* a certain number of II class stems to take the place within thirty years of the first class stems removed in the first rotation, third class stems also to be marked to replace the II class that have grown up. The IV class may safely be disregarded as they will always be very numerous. Then, and *only* then, can the Officer who is to mark for the subsidiary fellings set to work. He would do so without any qualms as to excess felling, and be guided by sylvicultural principles pure and simple.

The above system would prevent a drop in revenue in the second felling rotation, but it has been suggested to me that we might improve on that, and mark in reserve the number of II and III class stems that ought in the future to stand on the area as I and II class trees, and this is no doubt better.

Whether or not there is adequate cause for this alarm, I cannot be sure; but I often pass through areas that improvement fellings have traversed and see standing in them very little but III, IV and V class trees, while of trees nearing maturity there is a painful lack. In any case I feel we ought to so arrange matters for the distant future that no doubt as to a sustained yield shall remain. Perhaps some Officer can suggest a better plan than marking in reserve.

Possibility by Area.

BY G. A. F.

I AM glad to see Mr. Gleadow's notice of M. Broilliard's article on "Possibility and Rotation" in the March issue of the

Indian Forester. The article referred to by Mr. Gleadow is not by any means the first in which M. Broilliard advocates proportionate felling in preference to fixing the possibility by volume, though I am not sure how often he has referred to the subject, or whether any of his previous articles have been reproduced in the *Indian Forester*, as I have neither the back numbers of the *Indian Forester*, nor those of the *Revue des Eaux et Forêts* by me to refer to.

I wish Mr. Gleadow would enlighten us further as to how this fascinating method of proportionate felling is to be continued. In a previous article, I think in the *Revue des Eaux et Forêts* for 15th July, 1898, M. Broilliard explains how this method is to be applied to Oak in mixture with Beech, &c., to Spruce, and to Silver Fir forests, I think so far as concerns the " Coupes d' ensemencement " only, which I take it includes our preparatory and seed fellings. But how is the process to be continued? For spruce, for instance, he recommends the removal of one tree in 3 by groups, or say, 3 trees in 9. Two of these coupes would leave 4/9 of the original crop on the ground. Supposing two such coupes had in ten years resulted in a sufficiency of seedlings, how do we continue? Could we not apply some such simple prescription to all the regeneration fellings? I think we could. M. Broilliard shows that by taking two sets of coupes and making the first and third fellings in two coupes during the same year and similarly the second and fourth fellings in two other coupes the following year, and so on, the outturn can be very fairly equalised. What would appear to be required then is that the '*chiffre d'abatage*' should be fixed for our chief species. As M. Broilliard points out, however, his method has one serious drawback which may alone be sufficient to prevent its being generally accepted, and that is, that it is too simple. In India, however, the chimera of a sustained yield has not perhaps quite the same influence in it as on the Continent, so we may hope that even a simple method may have a chance of receiving consideration.

If Mr. Gleadow could be persuaded to give us his own idea on how one such simple method could be adapted to our wants in any given class of forest, I think there is no doubt some of us may be induced to rise from our long chairs to criticise or to approve. I quite agree with him as to the prescription of possibility by volume being unsuited to the selection method.

There can be no doubt that the simpler the method of prescribing the possibility the better, and the great merit of proportionate fellings in the regular method as M. Broilliard points out is, that it leaves the Officer entrusted with the marking free to devote his whole attention to the choosing of the best trees to mark, and relieves him of all anxiety about the volume, so that excellent results have everywhere been obtained by its adoption.

A Preliminary Note on Two New Destructive Bark-boring Beetles. *

By E. P. Stebbing, F.E.S.

Introductory Remarks.

In the month of August of last year (1900), Mr. Minniken, Deputy Conservator of Forests, in charge of the Bashahr Division of the Punjab Circle, discovered that his deodar (*Cedrus Deodara*) pole forests were being attacked by bark-boring larvæ. He reported the matter to Mr. Ribbentrop, at the time Inspector-General of Forests to the Government of India, and the latter went up and studied the attack on the spot. The notes which were the outcome of his observations on the deodar borer, and also on a kail (*Pinus excelsa*) borer, which he discovered doing severe damage to these trees, are embodied in this preliminary account of the life-histories of these two insects. It will be seen that there is yet much remaining to be observed.

Scolytus sp. (near to *Scolytus destructor*, Oliv.)

References.—This insect has been identified by Mr. C. O. Waterhouse of the British Museum as *Scolytus sp.* near to *Scolytus destructor*, Oliv.

Classification.—Order, *Coleoptera.* Family, *Scolytidæ.*

The beetles and larvæ bore galleries which are partly in the under surface of the bark and partly in the outermost layer of the wood. The insect has been reported as eating through the bark of deodar poles in the Bashahr forests and boring galleries in the wood below the bark. This fact is of interest, since I am not aware that the genus *Scolytus* has ever been previously reported in India as attacking Conifers. It does not do so in Europe, although it has been reported from America in this connection.

Life-history and description of insect.

Egg.—The exact period of egg-laying has not as yet been observed. Its European ally, *S. destructor* lays its eggs in June. The time at which our Indian species performs the same operation would appear to be somewhere about this month, since the larvæ were found by Mr. Minniken hard at work during August. It evidently varies with the elevation, since Mr. Ribbentrop observed that whereas at one elevation he noted larvæ already embedded in the larval galleries, higher up the females were swarming. Miss Ormerod † describes as follows the egg-laying stage of the European form:—

"The females may be seen early in June making their preparations for egg-laying by working their way along the bottom

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* Reference has already been made to these insects in articles in the *Indian Forester*: in Vol. XXVI (1900), p. 560, under the title of "The Insect Plague in Deodar Pole Forests," and in Vol. XXVII, pp. 26, 132, and 231.

† "Manual of Injurious Insects and Methods of Prevention," by E. A Ormerod, p. 216.

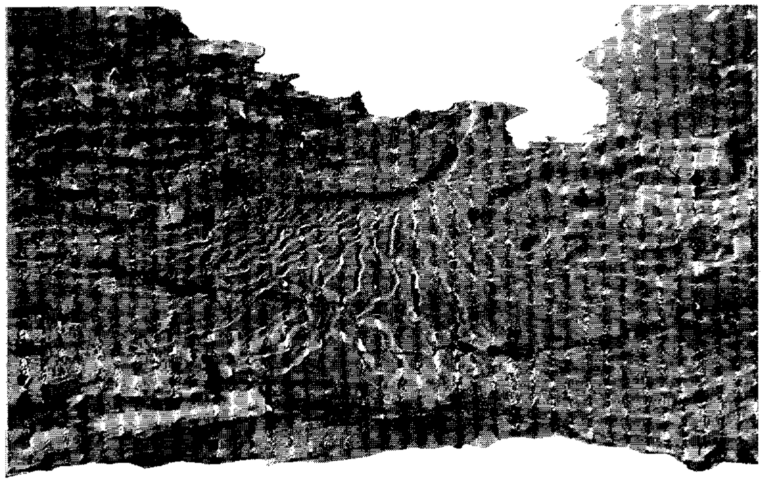

Fig. 1. Under surface of a piece of Deodar (*Cedrus Deodara*) bark showing galleries made by the beetle *Scolytus sp.*

Fig. 2. Under surface of a piece of Kail (*Pinus excelsa*) bark showing galleries made by the beetle *Tomicus sp.*

Life size from Photographs.

of cracks in the bark which they widen for some distance before beginning to burrow, so that the real opening of the galleries may be at some distance from the heap of rejected matter or little heap of wood-dust that marks the first point of entrance. The male is present for only a short time after the burrow is begun, before egg-laying commences. The burrow of the present beetle is usually about three to five inches long and takes about three weeks to form. The eggs are laid along each side of it, and are a hundred and upwards in number."

Larva.—The larvæ on hatching out start and bore at right angles to the parent gallery, their burrows which are regular gradually increase in size as the grub grows. From Mr. Ribbentrop's observations full-grown larvæ would appear to be present late in September and in October, when they form the little chamber or pupa-cradle noticed by him. In this they probably lie up as larvæ through the winter, changing to pupæ in the spring as is the case with their European confrère. This latter, however, has two broods in the year in Europe, although only one generally in England. When double-brooded, the larvæ of the first generation appear in July and spend about a month only or less in this stage, boring into the bark and outer wood. Beetles from these appear in August, and the larvæ from the eggs laid by these appear early in September and hibernate in their borings, pupating in the following spring.

Now we have seen that Mr. Minniken found larvæ at work in August, and Mr. Ribbentrop reports their presence late in September or into October. It follows that it is not at all improbable that our Indian species is also double-brooded, and this would account for the hiatus in the generations alluded to by Mr. Ribbentrop. The latter writes as follows:—

"The insect was first observed by Mr. Minniken in August last (1900), but is even now (1st October, 1900,) busy eating through the living bark of deodar poles, or engaged eating galleries below the bark. These galleries are regular. I have observed many old galleries, without a trace of the complete insect, with egg chambers at intervals . . . . . In many instances I found the white little larvæ curled up in the end of their galleries in the pupa-cradle, in others I found a hole whence the complete insect had evidently escaped. In no instance did I observe a complete pupa, though in two instances I found the larva enshrined in a web skin. Now it is quite evident that the egg chambers and larva galleries from the pupa-cradles of which the insect has found its way out, belong to a past generation, and possible that those in which the larvæ are still embedded are part of the present generation, which would indicate that the complete insect had been swarming for some time before it was observed. I am confirmed in this opinion by the fact that when I observed the larvæ already embedded, this happened at a somewhat lower elevation, whereas at a higher elevation the perfect insect was

more active. The question whether the former generation belongs to a previous year, or whether more than one generation appears in the same year, must remain for future observation. I have not sufficient material to solve the question. That, however, there has been a hiatus between the two generations is evident by not finding a single complete pupa. I am inclined to believe that the larvæ winter in the pupal chambers. This should be ascertained later on."

Now it must be remembered that this insect is living at a considerable altitude, and taking into account the life-history of its European ally, I am inclined to think that the two sets of larval galleries observed by Mr. Ribbentrop, *i.e.*, those containing larvæ and those in which the pupal chamber contained a hole through which the beetle had escaped belong to two different generations of the same year. Mr. Ribbentrop's attention was only drawn to the devastation in August, and he made his observations, I believe, in the latter part of September. By that time the larvæ from the galleries with a hole at these extremities would have already changed to the perfect beetle and left the tree boring their way out at the hole in question. The larvæ found in a web skin were probably already hibernating for the winter.

The larva is whitish, fleshy, wrinkled and curved; it tapers bluntly and is legless.

Pupa.—The pupal stage has not yet been observed. It will not improbably be a short one.

Imago.—The beetle is about an eighth of an inch in length and is black in colour, antennæ and legs being fulvous brown; small and cylindrical in shape; head projecting with a short broad rostrum; under-surface of abdomen is flexed upwards.

We have already seen that beetles are to be found early in October, and that they lay eggs producing the larvæ which probably hibernate as such during the winter. It has now to be ascertained whether these winter larvæ produce beetles which would appear about June. This will enable us to settle the point, a very important one, as to whether the insect is double-brooded or otherwise.

Locality from where reported.

The larvæ of this insect were discovered, as already mentioned, by Mr. Minniken, Deputy Conservator of Forests, attacking the deodar pole forests of the Bashahr Division in August, 1900. He reported the matter to the Inspector-General of Forests, and the latter went up and made a study of the attack on the spot. Mr. Ribbentrop wrote, "As regards the deodar, the attack is by no means serious, but it is evidently due to the large number of suppressed, and consequently seedy, trees in the young pole forests, and this would seem to furnish another reason for the early thinning of deodar thickets and poles." I have no doubt myself that Mr. Ribbentrop

has here hit the right nail on the head. The large number of sickly and dead trees remaining unbarked in the pole forests provided an immense supply of food for bark-boring beetles, and the usual result followed; they multiplied rapidly, and then attacked the surrounding living poles, and through sheer force of numbers were able to overcome and break down the resistance they met with. It will be remembered that when a green tree is attacked by bark beetles, *i.e.*, when the green bark is pierced through, it answers with a flow of sap. This would drown the burrowing beetles, but others fill their places and carry on the attack, and the answering flow of sap gradually becomes weaker and weaker, and finally ceases and the tree dies.

Specimens of this beetle with its larva were sent to me by both Messrs. Ribbentrop and Minniken; the former's diagnosis of the beetle as a *Scolytus* proved to be the correct one, and this would appear to be the first report of this genus attacking conifers in India. In Europe, as I have already mentioned, it confines its depredations to broad-leaved trees. I sent the beetle home to the British Museum authorities, and Mr. C. O. Waterhouse, who has very kindly examined it, informed me that it was very close to *Scolytus destructor*, the well-known Elm tree bark-borer.

It has yet to be decided whether the borer will prove a species new to science.

Note.—Accompanying the Scolytus beetles sent to me were some long reddish pink larvæ, evidently not the larvæ of *Scolytus*, which are small white curved legless grubs. Writing with reference to this larva, Mr. Ribbentrop stated :— "The matter (*i.e.*, the identification of the deodar-boring pest) has been somewhat complicated by the finding of a red larva in the galleries. This has been sent to Mr. Stebbing and others as belonging to the insect, which I identify as a *Scolytus sp.* It has, in my opinion, nothing to do with it, if not as an enemy. To begin with, it is about five to six times the size of the complete insect : has three pairs of complete legs ; has strong flat mandibles and two hooks to its other end, twelve distinct rings. Its colour is fleshy-pink." This pink larva belongs to the order *Coleoptera*, ann family *Cleridæ*, and is, as Mr. Ribbentrop correctly surmises, an enemy. The *Cleridæ* are cannibals, and these pink larvæ prey upon the *Scolytus* grubs, thereby no doubt exercising a certain amount of check on their too rapid multiplication.

Tomicus sp. (near to *Tomicus typographus*, Lin.)

Reference.—This insect has been identified by Mr. C. O. Waterhouse of the British Museum as *Tomicus sp.* near to the European form *Tomicus typographus*, Lin.

Classification.—Order, *Coleoptera.* Family, *Scolytidæ.*

The beetles and larvæ bore galleries in the bark and outer wood of the kail (*Pinus excelsa*) tree. They have been reported by Mr. Ribbentrop as doing serious damage in kail pole forests. The insect was at first thought to be identical with that attacking the deodar (*i.e.*, the *Scolytus sp.*), but on examination Mr. Ribbentrop found the pest to be a *Tomicus.*

Egg.—The date of egg-laying of this beetle has not yet been observed. In order to assist further researches into its life-history, I will give here a few notes on that of its European

confrère, *T. typographus*. This latter lives on the Spruce in Europe, and our Indian form is likely to resemble it in habits.

Life-history and description of insect.

T. typographus appears in the perfect state at the end of April or in May, at higher altitudes in June, and under favourable circumstances a *second brood* may appear in July and August.

This latter is of importance. The beetles are to be found in pairs boring into the trunks of large spruce trees under the crown, especially on the sunny side; when they reach the bast, they prepare a breeding chamber; after pairing the female excavates one or more galleries running in the long axis of the trunk which, besides the original bore-hole, may contain 2—5 air holes. On the right and left of the mother gallery, she bites out little recesses of the size of a poppyseed and lays in each an egg, generally to the number of 30 to 50, but sometimes as many as 120, which she covers with fine wood-dust.

These egg-receptacles may be seen in Fig. 2 of the accompanying plate.

Larva.—The larva was found at work in the kail trees in September, and it is probable that this would be the larva of the second brood. This latter supposition requires, however, careful observation and corroboration.

The Plate, Fig. 2, shows that our Indian *Tomicus* makes much the same sort of gallery in the kail bark.

The larvæ of the first brood of the European *T. typographus* appear 14 days after egg-laying in May and June, before the whole of the egg-laying is quite completed, and eat out slightly winding galleries in the bast, somewhat at right angles to the direction of the mother gallery. Our Indian species acts in much the same way, the winding galleries may be seen in the Plate, Fig. 2. The length of time the larva spends feeding is not yet known.

Pupa.—The larvæ pupate in a chamber at the end of the winding galleries which they bore in the bast.

Imago.—The beetle is about a quarter of an inch in length, dark-brown or yellowish in colour, shiny, hairy beneath, with scattered hair on the dorsal surface; head hidden beneath thorax and scarcely visible from above; thorax slightly longer than broad; its dorsal surface with rather fine sparse punctuation over the posterior half; tarsal joints simple; elytra have impressed striae, the intervals being punctured; elytra slope down at apex, the sloping portion excavate or impressed. Under-surface of abdomen flat.

Locality from where reported.

This insect was reported by Mr. Minniken in August, 1900, as attacking and killing kail poles in the Bashahr Division, Punjab. The attack was studied by Mr. Ribbentrop. He noticed that whilst the *Scolytus* attacking the deodar (already

mentioned) only appeared to attack that tree in clumps here and there, the *Tomicus* attacked the kail *en masse.* In a note on the subject he wrote :—

"The insect found in and destroying large numbers of *Pinus excelsa* poles is different" (*i.e.*, from that on the deodar poles), "though it was first considered to be identical. It is a *Tomicus*, of this, I have no doubt . . . . . The same insect is sometimes dark-brown, sometimes yellow as is the case in Germany. The larva-galleries and pupa-cradles are more irregular than with the deodar insect. Its attack, when it has taken place, is much more serious. I have not found the *scolytus* above described in *Pinus excelsa*, nor the *Tomicus* in deodar."

Specimens of this beetle were sent to me for identification. The insect, as Mr. Ribbentrop had recorded, proved to be a *Tomicus*, and Mr. C. O. Waterhouse, of the British Museum, kindly identified it for me as *Tomicus sp.* near to *T. typographus,* Lin. He wrote that the insect was new to the British Museum Collection.

Much remains to be done with reference to obtaining full information as to its life-history. The first and most important step is to find out how many generations it passes through during the year. The winter is probably spent hibernating as the perfect insect, under bark or in cracks of bark or stumps, and in spring the beetle bores through the bark and commences to lay her eggs. Search must be made for grubs in the spring. If such are found, the resulting beetles should be watched for and the month they appear noted. If it be in the summer months they will probably lay eggs which will hatch out at once, and we shall get the larvæ of the second generation during the rains. In Europe the entire development of a generation is passed through in ten weeks. It is evident from this that in the warmer climate of the lower Himalayas, at least two generations may be expected as the annual cycle of this pest.

NOTE.—*Hypohlæus flavipennis.*

Specimens of this beetle were forwarded to me, together with the *Tomicus sp.* Mr. Ribbentrop stated that they were found in the *Tomicus* galleries. He imagines, and correctly so, that these bettles are probably cannibals.

This beetle is a small heteromerus one and is carnivorous The beetles are simply present in the burrows to prey upon the *Tomicus* larvæ.

Attacks of Hyblœa puera on Teak Trees.

BY R. S. HOLE, F.C.H.

MR. STEBBING in his letter, printed on pp. 72 to 74 of the *Forester* for 1901, refers to a note by Mr. L. S. Osmaston, which appeared in the October Number of the *Forester* for 1900, on the subject of the present article, and says that as the larvæ noticed

by Mr. Osmaston pupated in the rolled-up end or edge of the teak leaves, they could not have changed into the moths which have been identified as *Hyblœa puera*, for the reason that the larva of *Hyblœa* always pupates on the ground and never does so in the rolled-up edges of the teak leaves. It has, however, occurred to me that Mr. Osmaston may perhaps be right after all, and my reasons are as follows :—

In the first place, Mr. Osmaston merely says that pupation takes place in the rolled-up end or edge of a teak leaf. It is not clear from this whether pupation occurred on the leaves on the plants, or on the leaves on the ground which had fallen from the seedlings. Presumably, however, the former is intended, and Mr. Stebbing appears to adopt this view. From observations hitherto recorded, it appears that the pupæ of *Hyblœa* are usually found on the dead leaves on the ground ; but, as far as I am aware, it has never been definitely proved that the larva does not, at all events occasionally, pupate on the leaves while the latter are still on the tree, the pupa then falling to the ground with the leaf to which it is attached. In the case of *Paliga damastesalis* I have found pupæ on the leaves on the teak trees, and have also found both, larvæ about to pupate and pupæ, on the dead leaves on the ground. I have also found that *Paliga*, in that part of the Central Provinces at all events of which I have had experience, hibernates in the larval stage, and that, when about to hibernate, the larvæ descend from the trees, on which they have been feeding, and usually, if not always, hibernate in the ground in cocoons made of silk and bits of earth. These cocoons are frequently found in clusters under stones and large boulders, but they are often seen at a depth of several inches in the soil. This hibernation appears to commence towards the end of October and pupation takes place in the ground in the hot weather of the following year. After the hibernating stage then at all events the pupation of *Paliga* frequently, if note always, takes place in the ground. The mere fact, therefore, of pupae being found on the leaves is not, I think, sufficient to enable us to definitely assert either that the insect is not *Hyblœa* or that it is *Paliga*.

Mr. Stebbing also lays stress on the fact that the *Paliga* larva pupates within the *rolled-up* leaf or edge of a leaf. This rolling-up of the leaf, however, appears to be by no means so general or characteristic a feature of this insect's attack as it is generally believed to be. I have frequently found that the larvæ when about to pupate take up their position in any small depression or hollow in the leaf which may prove convenient, and proceed to construct their cocoon there, swinging their heads quickly from right to left and from left to right, as they attach the thread to each side of the leaf and draw it across to the other. In such cases there is no rolling of the leaf, and there is obviously very little difference between the procedure here followed by the larva of *Paliga* and that adopted by the larva of *Hyblœa*, which Colonel Bingham tells us occasionally

forms its cocoon "along the mid-rib of a leaf dragging the sides of the leaf slightly together with the web." On the other hand, again, *Hyblœa* appears sometimes to *fold* the leaf in a manner closely resembling that which is usually followed by *Paliga*. On page 127 of the *Forester* for 1898 we have the following description of an insect subsequently identified as *Hyblœa puera*: "When the caterpillar begins to pupate it suspends itself by threads at either end to a leaf, not necessarily a dead leaf, spins a cocoon round itself and folds the leaf over so that it is quite snug."

Mr. Stebbing thinks that the larva described by Mr. Osmaston "will not improbably prove to be *Paliga damastesalis*." From Mr. Osmaston's description, however, I think it might equally well be *Hyblœa puera*. As far as our present knowledge goes, it appears that the larva of *Hyblœa* may at all events occasionally pupate in the rolled-up end or edge of a teak leaf. The pupal stage of *Hyblœa* is said to last from eight to eleven days. The length of the larva of *Hyblœa* is said to range from $\frac{1}{4}$ inch (after the first change of skin) to $1\frac{1}{4}$ inch (when fully developed), *vide* the account on page 128 of the *Forester* for 1898. All this tallies with Mr. Osmaston. It is noticeable also that the colour of the larva according to Mr. Osmaston is *dark-brown* or *black*, and this is certainly far more like *Hyblœa* than *Paliga*. In the account on page 128 of the *Forester* for 1898, the larva of *Hyblœa* is said to be pale-grey when young and dark-grey when full grown. Colonel Bingham describes the larva as "whitish yellow beneath, dusky greenish above." The larva of *Paliga*, on the contrary, is a light yellow-green when young, becoming pale sap-green when mature. Also, when about to pupate, this larva becomes a light primrose-yellow colour and the curious dark purple spots on the back then become very conspicuous and could scarcely fail to have been noticed by Mr. Osmaston.

Mr. Osmaston's pupa also is described as "one-half to two-thirds of an inch long." I am not aware of there being any recorded measurements of the pupæ of *Hyblœa*, but numerous measurements made by me of the pupæ of *Paliga* have shown that the pupa of this insect never exceeds one-half an inch in length and is usually only about three-eighths of an inch long.

Mr. Stebbing rightly remarks that *Hyblœa* is almost invariably accompanied by *Paliga*, and I have no doubt that, if Mr. Osmaston makes a careful search in his nursery, he will find *Paliga* more or less well represented, but I do not think there is sufficient evidence to show that the description of the larva and pupa given by Mr. Osmaston on page 516 of the *Forester* for 1900, is absolutely inapplicable to *Hyblœa puera*.

From the fact that these two insects, *Paliga* and *Hyblœa*, are so frequently found together, it is obvious that very careful observations, extending over several years, must be made before we can hope to draw up an accurate life-history of one or both of these pests. It is also obvious that, in the case of insects like these which have such a wide distribution throughout India and

Burma, it is necessary to collect information from all localities where they are known to occur, seeing that their life-history may vary somewhat in different localities.* Unfortunately, Divisional Officers, as a rule, have very little opportunity or leisure for making scientific observations, and it will obviously help us considerably in collecting reliable information regarding these insects if we can discover some means of readily distinguishing between the attacks of these two pests.

In a note printed on page 325 of the *Forester* for 1897, Mr. P. C. Thompson reported the attacks of a defoliating caterpillar in the teak forest of Damoh, and drew attention to the peculiar fact that these larvæ only destroyed the parenchyma of the teak leaves. leaving the veins and vascular tissue intact. At the time, Mr. Thompson was unable to identify the insect, but in the following year 1898, when I took charge of the Damoh Division, I noticed another attack of defoliating caterpillars which seemed in all respects identical with that noticed the previous year. As noticed on pp. 428-429 of the *Forester* for 1898, specimens of the larvæ, pupæ and imagoes were obtained by me and forwarded to the Indian Museum for identification, and were there pronounced to be *Paliga damastesalis*. The teak leaves attached are usually most beautifully skeletonised and, occasionally, only the upper layers of the parenchyma are destroyed, the leaf tissue not being pierced. I have bred several larvæ of this insect, and have watched them feeding on teak leaves in all stages of their development, but I have never found them destroy the veins or nerves of the leaf It is to this fact that the forests which have been badly attacked by *Paliga* owe their characteristic sombre-brown colour noticed by Mr. Thompson, and which is very striking during the monsoon months, when the rest of the country side is green. The larvæ of *Hyblœa*, on the contrary, devour the whole tissue of the teak leaf, leaving only the middle and main nerves. I have invariably found this to be a most constant characteristic in the Central Provinces, and if it holds good elsewhere, the fact will, I am sure, render it easy to distinguish the attack of *Paliga* from those of *Hyblœa*, at all events in the case of teak.

It has been frequently noticed in the mixed forests of the Central Provinces that, simultaneously with the attacks of *Paliga* on teak, *Anogessus laifolia, Stephegyne parvifolia, Adina cordifolia, Terminalia tomentosa,* other trees are also defoliated by a caterpillar. In the case of such trees also, the whole of the leaf tissue is destroyed, leaving only the mid-rib and main veins. At first sight one would be inclined to attribute this to *Hyblœa*. I have, however, noticed that when the teak have been absolutely

* Mr. E. P. Stebbing, Forest Entomologist, Imperial Forest School, Dehra Dun, will be glad to receive information and specimens from all parts of India during the different months in which the insect appears—HON. ED.

defoliated by *Paliga*, and when I have not been able to find a single specimen of *Hyblœa*, I have still found the foliage of *Anogeissus latifolia*, and of other trees destroyed as noticed above. I am consequently inclined to think that *Paliga* will attack trees other than teak, and that when this is the case it is apparently impossible to readily distinguish between the mode of attack of the two insects.

I have made careful notes regarding the habits and life-history of *Paliga* in the Damoh and Jubbulpore Divisions of the Central Provinces during the years 1898 to 1901, and I hope to ultimately give the results to the *Forester*, when I have been able to draw up a complete life-history of the insect for these provinces. As far as my observations go, however, they point to the following conclusions which I venture to enumerate with the hope that they may be useful for comparison with observations recorded in other localities, and may help us to draw up a complete account of the insect for inclusion in Mr. Stebbing's "Injurious Insects" :—

(*a*) As already mentioned above, *Paliga damastesalis* hibernates in the larval stage and hibernation commences from the end of October to the beginning of November, when the larvæ leave the trees and construct cocoons for themselves in the ground. Hibernation appears to last about 22 weeks, after which pupation takes place in the ground, and the moths emerge about April.

(*b*) The pupal stage usually lasts about eight days and the larval stage three weeks. The exact time for a complete generation I have not been able to accurately determine, but it seems to be about six weeks, and as many as five broods usually appear to be developed during the year. It also appears probable that the larvæ of one or more of these broods may live chiefly on some tree or trees other than teak.

(*c*) After hibernation some insects appear to pupate considerably earlier than others of those kept by me; the first insects which pupated did so just three (?) before the last. The early larvæ of the first brood would therefore emerge three weeks before the later larvæ of the same brood, and taking the time for a complete generation as six weeks and the length of the larval stage three weeks, there would appear to be a continuous chain of larvæ from the date of emergence of the earliest larvæ of the first brood to the date on which the latest larvæ of the last brood begin to hibernate. It should, therefore, be possible to find larvæ at any time during this period. From July to October I have invariably found larvæ present, and I think that if a careful

search is made they will also be found earlier in the year. All stages of the growth and development of the insect may frequently be found at the same time and on the same leaf. I have often seen larvæ of all sizes from one-twelfth of an inch to one inch in length together with pupæ.

(*d*) Pupation generally takes place on the leaves which have been attacked by the larvæ, except after the hibernating stage, when it takes place in the ground.

Regarding *Hyblœa*, unfortunately my notes are still very incomplete. It is, I think, generally believed that this insect has at least two broods in the year. In July, 1900, teak, *Millingtonia hortensis* and several other trees in Jubbulpore were defoliated by this insect, and during that year there appeared to be only one brood here of which any considerable number of larvæ developed. The trees which were then attacked in July, put out a second flush of leaves in the following September, and these remained practically untouched, except in the case of teak, which tree was as usual attacked by the larvæ of *Paliga* in September and October. The south-west monsoon in 1900 was unusually late and did not arrive in Jubbulpore until July. During this month also there was a good deal of sunshine, alternating with short showers, and the fact that heavy rain was not continuous appears to have favoured the development of *Hyblœa*. After July rain was more or less heavy and continuous, and this may have accounted for the failure of the insect to attack again in September-October. A reference to the account, printed on pp. 126—129 of the *Forester* for 1898, of the insect subsequently identified as *Hyblœa*, shows that very dry and very wet weather has seemed to be detrimental to the spread of the insect in Southern India. From this account also it appears that the principal larval attacks have been noticed in April-May and again in September-October. No attack in July appears to have been recorded, but it seems probable that there are at least three broods of the insect in the year. When more accurate observations have been made regarding the period required for each stage of the insect's metamorphosis, we shall find, I think, that there may be more than three broods in the year, one or more of them being frequently prevented from developing by some unfavourable circumstances. *Hyblœa* certainly appears to be far more susceptible to injurious climatic influences than does *Paliga*.

In conclusion, I will note a few facts which appear to indicate that there is likely to be more similarity between the life-histories of *Hyblœa* and *Paliga* than appears to be generally thought.

(*a*) *Paliga's* habit of letting itself down from the trees to pupate in the ground, as noted in para. 2 above, is clearly very like that of a large number of noctuid larvæ to which family *Hyblœa* belongs.

(*b*) The pupal stages of both insects appear to last the same time, usually eight days.

(*c*) From the account published on p. 128 of the *Forester* for 1898, it appears that the larval stage of *Hyblœa* lasts 19 days. From observations made by me last year it appears that the larvæ stage of *Paliga* takes the same time, *i.e.*, about three weeks.

JUBBULPORE:
The 20*th November*, 1901.

A Note on the Self-sowing of the Kusli Grass (Heteropogon contortus) seed.

BY L. K. MARTEN, *Berar Forest Service*

NATURE'S methods for the distribution and self-sowing of plant seed are numerous, but that of the seed of the "Kusli" grass has struck me as being most ingenious.

There are few who have had occasion to wade through open grass-lands early in November, clad in other than "Khaki" or some stout non-fluffy cotton fabric, who are not only too well acquainted with the "Kusli" or spear grass.

According to native classification, there are in Berar three kinds of "Kusli" grass :—

I.—The *Tâm*, a tall grass, generally found growing in damp rich soils and attaining a height of 6 feet; it produces an ear with only two or three large "kusals," a very formidable looking spear, but comparatively harmless.

II.—The "*Kusli*" *proper*, a grass found growing over large areas of more or less open forest land and on a variety of soils, seldom growing above 2 feet in height.

III.—The *lesser Kusli* or "*Bhurani*," a short grass found growing on dry slopes where lime predominates, seldom grows above one foot in height.

The seeds of all three begin to ripen towards the end of October or beginning of November; that of the *Tâm* soon falls to the ground and is lost sight of. In the "Kusli" and "Bhurani" the seeds, which are numerous, are borne in an ear, and each is a regular quiver full of small arrows; on ripening, these small spear-like seeds, with their hair-like appendages, burst away from the sheath and collect into small matted masses, which in the case of the Kusli are long or irregular in shape, and in the Bhurani each cluster forms itself into a perfect ball.

On examining these matted masses of seed, it will invariably be found that the little spears are all pointing outwards, and as they thus hang amongst the grass are on the *qui vive* for the

unlucky passer-by (man or beast) in whose coat they may find a billet, and thus get carried free to pastures new.

The less fortunate spears hang on a little longer, then give up hope of obtaining free transport, disentangle themselves and slide down to the soil.

On touching the soil the small spears start working their way into it, assisted by a peculiarly powerful screw-like action set up amongst the hairy appendages, caused by contraction and expansion of their fibres, due to the drying of the nightly dews by the sun's rays.

This may be seen at any time by removing the grass from a small patch where Kusli abounds, when the whole of the soil below will be found covered thick with a coat of what has the appearance of brown hair or bristles; in fact the ground looks like a coarse brown bear's skin.

Pull some of these bristles up and you will find at the end of each a Kusal seed which has been deeply imbedded in the soil, that they have worked their way under and between the crevices of large boulders for a considerable distance, and have thus sown themselves.

Now drop a few drops of water on these bristles and they will immediately start curling and twisting round as if alive; this peculiarity was apparently long ago spotted by the wily Indian juggler, for they *will often produce a small packet of* these Kusli bristles, and, after repeating various weird formulæ, proceed to moisten them and bring them as it were to life.

During the late severe drought experienced in Berar, great scarcity of fodder prevailed; every blade of grass that could be found in the reserves was cut and removed, and ultimately even the old unburnt refuse, the accumulation of years in fire-protected forests, was swept up and used for fodder.

In the past monsoon the rainfall was generally abundant, and a luxuriant crop of grass came up; but a most noticeable feature in the new crop *is the great diminution, in fact in some localities* complete disappearance, of the better qualities of fodder grasses and the marked predominance of Kusli.

As none of the grasses had a chance of seeding the previous year and removal was wholesale, irrespective of kind or quality, the abnormal increase in Kusli is remarkable and difficult to account for.

It is quite possible that the inferior qualities of grass are deeper rooted and escaped being scraped up for fodder, or that they are better able to withstand protracted droughts; but personally it has struck me that *this deep self-sowing, with possibly the* power of lying quiescent in the soil for a considerable time, accounts for the marked increase in "Kusli" grasses.

The matter may perhaps be of some interest in connection with fodder reserves.

The International Congress of Sylviculture.

By J. S. Gamble, C.I.E., M.A., F.R.S.

This Congress was one of the first of the long series of International Congresses which took place at the Great Exhibition, and it is, it is hoped, to be the first of a long series of important Forest Congresses to be held at short intervals in the future. It opened on the 4th June, in the Congress Palace, close to the Alma Bridge. There were delegates present representing most of the countries of the world, but, naturally, the great majority of those who followed the discussions were French, mostly gentlemen connected with the Forest Service. So far as is known, England was represented only by Mr. Stafford-Howard, Commissioner of Woods and Forests, and India by Dr. Schlich and Messrs Fisher and Gamble, all old Indian forest officers. Messrs. Cadell, Moir, Hearle and Carr were also present to represent the Indian Forest Service unofficially.

The proceedings of the Congress opened with an introductory speech by M. Jean Dupuy, the Minister of Agriculture He began with a welcome to the foreign members, and then proceeded to discuss the position of the Exhibition as "not only a marvellous spectacle offered to the world, but also presenting, for all civilised people, a powerful interest as being the résumé, the synthesis, the relief map, so to speak, of human progress." He then proceeded to show how Sylviculture, so important in the economy of nations, could not fail to take a place, a great and honourable place, in the Exhibition. The Minister was followed by the Director-General of Forests, who, after thanking him for presiding and opening the Congress, pointed out the importance of an international understanding on the subject, so as to take stock of the forest resources of the world, in view of the probable wood famine which, before long, may be expected to be a serious difficulty.

These preliminaries were followed by what was the most important paper read before the Congress, that by M. Mélard, Inspector of Forests, on the insufficiency of the supply of building timber in the world. In an able discourse, he pointed out that the supply of such timber was already diminishing, that most countries actually at the present day were importing more timber than they

exported, and that in those few countries where the exports still exceeded the imports, there were serious signs of the supply falling short before long. Taking the nations in order, he discussed the question as regarded each of them; and gave statistics, both of the quantity of material imported and exported, and of the value *of the excess of one or the other. The following average figures* of the values will be found interesting. They are in millions of francs.

	Excess of Imports.	Excess of Exports.
Great Britain	471	...
France	99	...
Germany	344	...
Belgium	102	...
Holland	18	...
Denmark	31	...
Spain	30	...
Portugal	5	...
Italy	31	...
Switzerland	15	...
Greece	3	...
Bulgaria and Servia	3	...
Austria-Hungary	...	199
Norway	...	47
Sweden	...	198
Finland	...	89
Russia, ...	...	134
Roumania	...	5
United States	...	101
Canada	...	127
British India	...	14
China and Japan	4	...
South Africa	9	...
Mexico	2	...
Argentina	26	...
	1,193	913

He went on to point out how the excess in Austria-Hungary, Russia and the United States was much threatened, partly by increase of population and partly by industrial development; and how the excess in Norway was menaced by the deterioration of the forests; so that there only remained three countries where the forest resources were capable of helping in the future, *viz.*, Sweden, Finland and Canada, but that what they could produce was quite insufficient, in presence of the increase in population and the development of industrial work, not only in Europe and America, but in China, Australia, South America and South Africa, so that it was clear that we were on our way to a timber famine. He gave us fifty years only before such a catastrophe should take place. His recommendations were—(1) that the destruction of forests should be stopped, partly by strict legislative measures on the part of Governments, partly by making private forest owners understand that their interests lie in taking care of the capital stock, and only exploiting so much as may be calculated to be the interest on it; (2) that forest property should be helped by not being too heavily taxed; (3) that measures should be at once

taken to utilize all available waste lands by replanting and restoration. The paper was listened to with very great interest, and the thanks of the Congress unanimously voted to M. Mélard.

On the 5th June, the first work done was to subdivide the Congress into three sections, *viz*., (1) Forest Economy; (2) Influence of Forests from the point of view of the maintenance of the soil, the water supply, and of meteorological phenomena; and (3) Application of Natural Sciences to Sylviculture; and this having been done, the sections separated to carry on their deliberations, which continued on the 5th, 6th, and 7th.

In the First Section, the *first* subject was the question of the treatment of silver fir forests, and the advisability of converting into forests of silver fir all coppice lands of poor growth in mountain regions. The chief speakers were MM. Runacher, Huffel, and Mer. No very definite conclusion was arrived at, it being agreed that the best method of treatment for silver fir forests was still in doubt. Then came the important question of thinnings, discussed, after the reading of an able paper by M. Broillard, by M. Boppe and M. Mer especially. It was generally agreed that the principle to be followed in thinnings was that of working by careful regard to canopy, that the canopy should be lightly opened but not interrupted, and that the undergrowth should be carefully respected. The *third* question was that of the utility of cultivating the soil in regeneration fellings, and it was generally agreed that such cultivation, accompanied by artificial seed sowing, was most useful. The *fourth* question, the treatment of coppice under standards, so as to increase the production of timber material, gave rise to considerable discussion, and it was agreed that in those cases where good oak saplings were not to be found in sufficient number to give a good series of reserves, groups of coniferous trees might be planted, under which afterwards the oak might reappear, the conifers serving to give a considerable amount of useful produce. The *fifth* subject was the address by M. Mélard, to which reference has already been made; and the *sixth* was a paper by M. Guyot on the subject of international legislation for mountain forest lands. The *seventh* subject was that of the use of exotic, acclimatized, or naturalized species of trees in forest growth. The cultivation of exotic trees at Vaux (Loir et Cher) was described by M. Cannon, and an important paper was read by M. de Vilmorin on the exotic forest trees found in France; while M. Pardé, whose experience of the cultivation of exotic trees was drawn from those of the Domaine des Barres, in the Loiret, originally planted by the De Vilmorin family, and now the property of and worked by the State, described the chief exotic forest trees from the forest point of view. It was agreed that more experiments were required, and that the results of such experiments should be carefully watched, recorded, and made public. The *eighth* subject was that of experimental stations, and here also it was agreed that more such stations were wanted in France, and that they should be

better connected with each other, the results of their researches being regularly published.

In the Second Section, the first subject discussed was forest meteorology, and the influence of forests on the subterranean waters in the plains regions; the result of the discussion being that it was agreed that more accurate study of the action of forests on springs and on hailstorms required to be undertaken at all experimental stations, and that orographic maps ought to be prepared, showing the density of forest growth in different regions, so that the question might be more fully discussed at the next Congress. The rest of the subjects chiefly regarded the great works undertaken in France for the restoration of denuded mountain slopes; the works necessary for the protection of mountain forests from avalanches; the regulation of hill pasture; the reclothing of dunes on the sea-coast; and the protection of forests from fire. The latter subject gave rise to a long discussion, in which many foreign foresters took part, the general gist of which was to show the great importance which the subject possesses for all those forest lands where fire is possible and the means of prevention inadequate.

The Third Section was chiefly occupied in discussing the need for experiments on forest soils, the necessity of having good botanical forest maps, and the improvement of systems of forest transport.

The final sitting of the Congress was a general one, and was very largely attended, for there were many French and other foresters interested in the important question of the permanency of the Forest Congresses, and whether such Congresses should be held as a separate institution, or whether they should he held at the same time as, and as a section of, the Congresses of Agriculture. After a long discussion, it was finally agreed that there were many advantages to be obtained from the Forest Congress being made a branch of that of Agriculture. The President, then, M. Daubrée, closed the sittings by thanking the members for their presence, and for the valuable assistance they had afforded to the important discussions.

The visit of the members of the Congress to the forest exhibits of the different countries at the Exhibition, was made on the afternoon of the 8th. The members met in front of the splendid Forest Palace, and began their sightseeing with the magnificent pieces of timber lying outside, which were explained and discussed by MM. Rudolph and Bouvet. These pieces consisted of huge logs of oak and silver fir. Then we visited, led by M. Thil, the French forest exhibit, with its splendid collections, its beautiful photographs and water-colour pictures of mountain restoration works, and its well-arranged collection of hunting trophies. In turn we then explored, in each case under the guidance of the officers in charge, the great collections exhibited by Russia, Austria, Hungary, Roumania, Canada, the United States, Japan

and Sweden. From the Forest Palace we passed to the Trocadéro, visited the Algerian section, the exhibits of the Imperial Russian Apanages in the Siberian Court, and the collections of British India and West Australia.

The most important of the collections exhibited were, after the French Government one, those of Russia, Austria and Hungary, between which there was little difference to be noted in respect to excellence. The exhibits of Roumania, Canada, Sweden, Japan and the United States of America were also of importance; while of those which were housed apart from the Forest Palace, the most noticeable, undoubtedly, were those of British India, West Australia, Algeria, Russian Siberia and the French Indies.

In the French Section, the chief interest lay in the "*reboisement*" works, the Forest administration being clearly especially proud, as well it might be, of the work they have done in stopping the damage done to the cultivated lands in the valleys of the Alps and Pyrenees by the constantly increasing devastation of landslips. These works have now gone on for about forty years, with the most satisfactory results. The Government has spent about $2\frac{1}{2}$ million pounds sterling, and have reclothed more than 600 square miles of country, stopping landslips, rendering torrents inoffensive, and safeguarding from damage very large areas of valuable land which had previously been threatened. The works undertaken were illustrated in the Exhibition by a beautiful series of water-colour drawings and large photographs, and by a diorama in two scenes, one showing the same locality as the other, but at the end of ten years after the commencement of work. "*Reboisement*" work is naturally carried out in different ways, according to the different characters of the localities, but, speaking generally, the first thing is to regularize the beds of the torrents by means of barriers, which usually consist of fascine-work at the top of the ravines where there is not much water, and heavy masonry walls below, where the current is strong and many boulders are brought down. Trees and cuttings are planted near the streams, and the seeds of grasses and herbs and bushes are sown in order to create a vegetation; tree-planting being usually only carried out afterwards, when that vegetation is assured.

In the French Section also, the fixing of sand-dunes, the methods of stopping avalanches, road-making and house-building, were all well illustrated, and there was a large collection of the woods and products of the French forests, and of the many valuable publications which have been prepared by members of the forest staff. And here it is right to mention the great liberality with which the French Government presented free to the members of the Congress copies of the valuable papers written specially for the Exhibition. The most noticeable of these papers was that of M. Mélard on the probable early wood famine, to which allusion has already been made. "*Reboisement*" works

are dealt with in a long series of a dozen or more interesting papers. M. de Gorsse discusses the treatment of the torrents of the Pyrenees; M. Champsaur, those of the classic grounds in the Lower Alps; M. Bernard, those of the Upper Savoy mountains, especially the valley of Chamouni; and the landslips in that same valley, and especially that which overwhelmed the baths of St. Gervais in the night of 11th July 1892, are described in a long and admirably illustrated paper by M. Kuss. The torrent of Rieulet, in the Pyrenees, is fully described by M. Dellon; and the methods of settlement employed at Pellafol, in the Isère, by M. Bernard. The best kinds of herbs and trees to use in the works are fully treated in an interesting paper by M. Bauby. Messrs. Campardon and Buisson discuss the systems of improved pasturage; M. Campagne the works necessary to protect forest and uncultivated lands against avalanches; and M. Calas the recommendation of the extension of the use of Salzmann's variety of the *Pinus Laricio*, which has been found valuable in "*reboisement*" plantations. The same author has a monograph of the processional caterpillar of the moth *Cnethocampa pityocampa*, with suggestions for the best system of counteracting its ravages.

Among other subjects on which important papers were printed and distributed, may be especially noted M. Lafond's work on the sand-dune plantations on the coast of the Bay of Biscay; M. Delassasseigne's very interesting paper on fire-protection; and M. Arnould's work on international measures necessary for the protection of useful birds.

In the Russian Section, the most noticeable exhibit was the fine series of sections of trees. As is well known, the forest flora of Northern Russia is a very poor one, the chief forest trees being the spruce and Scots pine; but in Siberia and the Caucasus there are many other species, and the value of their timber is well illustrated by the sections. Canada and Roumania have also fine series of wood sections, whose preparation must have been a difficult work. The Austrian and Hungarian sections have no very special exhibits, but they have represented almost every branch of forestry, and more especially those branches which belong to forestry in its scientific side; working-plans, experimental stations, researches on rate of growth, "*reboisement*" works, planting and sowing are fully shown, as fully as are the methods of extraction of timber, and the utilization of forest products in general. Both of these countries presented to the Congress for free distribution, copies of valuable papers on forestry. The most important of those presented by Austria is the official guide to the forests, published by the Ministry of Agriculture at Vienna, and official papers on forest police and forest '*reboisement*' are also of great interest. The question of beech in the Austrian forest is the subject of a paper by Herr Hufnagl; and a full, well-illustrated account of the small forest

wood-industries of Austria is contributed by Professor Lauboeck. The '*reboisement*' works in the Karst region, that curious denuded tract of mountain slopes on the Illyrian coast, are fully described in a paper by Herr Pucich. The treatment of spruce forest, and the best systems of preventing the barking of the trees by large game, or the death and damage of forest growth by bad procedure are discussed by Herr Hermann Reuss.

The Hungarian contributions to the literature of the Congress are too many to be all mentioned here, but it is right to call attention to Herr Vadas's history of the Forest School of Selmeczbanya, and the same author's very interesting paper on the cultivation of willows as a protection against inundation. The Government publications refer (1) to the forest law of 1879; (2) to the preparation of working-plans; (3) to the organization of the forest staff; (4) to forest experiments and experimental stations; (5) to the organization of special schools for forest guards; and (6) to the history of the National Forest Society. And here it is also right to mention a very interesting account of the development of sylviculture in the Austrian territories of Bosnia and Herzegovina, by Herr Petraschek, who was himself present at the Congress to represent these provinces.

The forest exhibits of the United States were chiefly intended to illustrate forest utilization; the most noticeable features of their section were the beautiful transparencies in the windows illustrating the giant trees of the Western States, and the panels and sections of fine-grained woods in the American châlet.

In the Japanese Court, richly marked bamboo culms formed a remarkable exhibit, as did the huge planks of *Cryptomeria* and other woods.

In the Swedish Section the Congress admired a diorama picture of a pine forest, with a lake and mountains beyond, lit up by the glowing colours of a northern sunset; the large model of a saw-mill and timber export yard in the Gulf of Bothnia; and a pyramid of wood paving blocks marked with the brands of the various firms dealing in that important and increasing article of trade.

In the British Indian Section, the inspection by the Congress was hampered by the great crush of other sight-seers, still, though the crush was detrimental to a full appreciation of Mr. Ribbentrop's beautiful trophy and the carved showcases of the Schools of Art of Madras and Lahore, the Congress was able to see fairly well the forest show in the galleries, and admire the maps and plans, the fine photographs, and the Dehra Dun collection of products destined to be preserved for the future at Kew.

In the West Australian Court everybody was interested in the huge sections of "Karri" and "Jarrah" which stood sentinel before the doors, and in the excellent way in which the exhibition of these woods had been taken advantage of to serve two purposes, the embellishment of the Court and the display of the capabilities

of the woods. They had been employed in the paving of the Court to show their use as paving blocks, in the paving of the stairs in small cubes to show their use for inside floorings, in the balustrades and railings to show their capabilities for furniture and interior decoration, and in railway waggons to show their use for carriage-building. The whole display was most creditable, and was greatly admired by those members of the Congress who stayed on to the end. We had a long afternoon, and most members were very tired when their labours were over. It is scarcely too much to say that had the Forest Palace and its exhibits, increased by the inclusion in it of the collections of those countries who, perhaps mistakenly, preferred to be represented in their own special buildings (no mention has here been made of the forest exhibits, many of great importance, shown by Italy, Finland, Servia, Mexico, and other countries in their own exhibitions in the national palaces, as they were not visited by the Congress), been a separate Exhibition apart from the other portions of the great world's show, and displayed, like the Edinburgh Exhibition of 1884, as a separate thing, they would have formed a collection which alone would have attracted crowds and been a wonderful success.

The last day of the Congress, June 9th, was devoted to an excursion to the Forest of Fontainebleau, one of the largest of the Government forests of France, containing 17,000 hectares. It was a whole day's excursion, and was a very enjoyable one, both from the forest point of view and from that of the scenery, and the members received the greatest help and courtesy from the Inspector in charge, M. Reuss. The party was headed by M. Daubrée, Director-General, and there were representatives of almost all the nations of Europe.

The party left the Lyons terminus early, and arrived at Fontainebleau at 10-30 A.M., where carriages were in waiting, and a start was at once made, in rather hot weather, for a drive round the most interesting parts of the forest. At midday the restaurant at Franchard was reached, and the party were saluted with the strains of the well-known, '*cor-de-chasse*' welcoming them to the déjeuner. After the meal, speeches were made by members of most of the nationalities represented, and the excursion was then continued to other interesting parts of the forest, ending up at the railway station, where the train was taken at a little before 6 P.M. The forest of Fontainebleau is chiefly on sandy soil, with here and there small outcrops of the chalk, and the chief and most important tree is the oak, of the variety *sessiliflora*. Oak constitutes about 50 per cent. of the individual trees of any size in the forest, and its growth is excellent, Fontainebleau being one of its best localities in France. Some trees still exist known to be over five hundred years old, and to have more than 6 feet in diameter. The few oaks of the variety *pedunculata* found here and there are probably the result of sowings of acorns collected

elsewhere. Next in importance among indigenous trees is the beech, which is found to the extent of about 15 per cent.; but the trees are not very good, and they are more valuable for the help which they give sylviculturally to the good growth of the oak than for their industrial importance. Among other broad-leaved trees common in the forest, the hornbeam and birch are most noticeable. A considerable area is covered with Scots pine, which is, however, not indigenous, having been introduced so recently as 1786 in the first plantations made at that time by Dr. Lemonnier, the first physician to King Louis XVI. The seeds were brought from Riga, in Russia, and this circumstance was taken advantage of by M. Kern, the Director-General of the Imperial Forest School at St. Petersburg, at the déjeuner, to emphasize the close relations between Russian and French forest officers. The greater part of the pine forests were, however, planted in 1830—1848, and the *tree is now completely naturalized. Unfortunately, of late years,* the extension of touring, especially by cyclists and auto-car drivers, has had the serious result of causing extensive fires, usually lit by the careless use of wax matches and vesuvians, so that not only is it necessary for the staff to be constantly on the alert in dry weather, but endeavours have had to be made to replace the pine by less inflammable species.

The first Working Plan of the forest was made in 1861, and under it 13,724 hectares were devoted to high forest, 1,618 hectares to coppice, and 1,631 hectares to special working. This plan was kept in force and worked till 1880, when, owing to much damage done by frost and snow, many of its provisions had to be suspended and the dead wood cleared out. A new Plan was then found necessary, and this was made and brought into force in 1892. This new Plan divided the forest into five sections, which it will be interesting to enumerate.

	Hectares.
Section 1.—*High Forest of Broad-leaved Trees.*	
9 working circles, treated, on a rotation of 120 years (4 periods of 30 years), by the method of successive regeneration fellings (shelter-wood compartment method)	7,239
Section 2.—*High Forest of Conifers.*	
3 working circles, treated, on a rotation of 72 years (8 periods of 9 years), by the same method	3,292
Section 3.—*High Forest in Selection.*	
5 working circles, with a rotation of 7 years for the selection fellings,	2,975
Section 4.—*Coppice with Standards.*	
3 working circles, with a rotation of 30 years for the coppice ...	1,758
Section 5.—*Artistic Parts.*	
1 working circle, without fixed system, maintained to preserve ancient trees and picturesque localities	1,616
	16,880

And this is the Plan which is now in force, and which is giving such excellent results.

In a Congress at which so many foresters from all parts were assembled, there were naturally several interesting meetings of a more convivial character. On the 6th a déjeuner was given at

the Restaurant de la Belle Meunière, close to the Jéna Bridge, by the French members of the Congress to their foreign guests. There were many speeches, and the excellent fare and the cordial reception were greatly appreciated. On the 7th, again, the foreign members were invited to the dinner given by the Mutual Aid Society of Forest Officers in the splendid Salle Hoche, where the hospitality of the French hosts was again unbounded, and the evening was spent in the harmony which usually characterizes such forest réunions.

There can be no doubt that the Forest Congress of 1900 was a great success, and it may be hoped that future ones will be equally so, and that the cordial and excellent understanding which animates Forest Officers of all countries, whose subject has no relation to the difficulties of current politics, will tend to improve the mutual relations of these countries amongst themselves, and make for that permanent peace which all those who desire the welfare of the human race must ardently wish for. For the first of the series of great Forest Congresses, no better hosts could be found than the French; for hardly anywhere, after all, is hospitality and good-fellowship so thoroughly understood as in France, especially when the whole of the meeting is animated by the same *esprit-de-corps*, the same intense interest in all that appertains to the management of forests and the extension over the world of the benefits of forest conservancy.—*Transactions of the Royal Scottish Arboricultural Society.*

The Harmfulness of Bush Fires in the West Indies.

BY DR. H. A. ALFORD NICHOLLS, C.M.G., M.D., F.L.S.

I HAVE been asked to read a paper at this Conference on Bush fires and their harmfulness to the soil and to vegetation in those islands in which they are not controlled by legislative enactment.

The subject is one which has engaged attention for some years past, and I have spoken and written a good deal about these fires and their harmful effects in those West Indian Colonies in which they are allowed to rage without interference. It follows, therefore, that most of what I have to say to you has been made public by me elsewhere in some form or other.

Now-a-days, however, it too often happens that useful legislation is delayed until its necessity is brought home to the Government and people by frequent discussions, by the reiteration of arguments, and by the constant statement of facts bearing on the subject. This, I hope, will be the last effort that will have to be made to bring about the much needed legislation to control bush fires, for I trust that the discussion which will follow the reading of my paper will crystallize the facts into such a concrete form as to allow the question to be dealt with satisfactorily by the various

Governments concerned—the Imperial Department of Agriculture of course assisting by its advice and, if necessary, its initiative.

It may be well, perhaps, for me in the first instance to state briefly what steps have already been taken to bring the question before the public. In July, 1899, after a certain amount of discussion and correspondence, I raised a debate in the Legislative Council of Dominica on the destruction caused by bush fires in the island, by moving the following resolution :—

Whereas it is the custom during the dry season for peasants and others to clear lands by setting fire to dry grass and brush thereon;

Whereas in many instances such bush fires having escaped control have run on to cultivated and forest lands, causing considerable destruction and entailing great loss to planters, as well as interfering with the progress of the Presidency towards prosperity;

And whereas, such fires, by destroying seedling indigenous trees, prevent the reafforestation of the waste lands on the leeward side of the island, thereby causing these lands to remain barren;

Be it resolved—That in the opinion of this Council it is desirable to empower the Governor by Legislative enactment to issue his proclamation in times of drought forbidding for certain periods, under severe penalties, the setting of fire on any lands whatever, unless in special instances permission in writing be given by an authorized official.

This motion gave rise to an interesting and instructive debate, during which the harmfulness of bush fires was borne testimony to by the Councillors, some of whom detailed the destruction worked by fire on their own properties. The resolution, I am glad to say, was passed unanimously by the Legislative Council, but the Government has not yet introduced a draft Ordinance to deal with the question. Afterwards the West India Committee communicated with me on the subject, informing me that they had requested their correspondents in Antigua and St. Kitts to do what they could to get a similar resolution passed in the Legislature of those islands. Later on, the Governor of the Leeward Islands, in an address to the Antigua Council, pointed out the necessity of counteracting the evils caused by bush fires in the country districts; and there has been, I understand, some official correspondence on the subject with the Secretary of State for the Colonies. It had been decided that I should bring the matter before you at the last Conference, but I was unable to attend the meeting, and, as no definite action was taken by the local Government, I read a paper on the subject at a meeting of the Dominica Agricultural Society on May 30th, last year, not only in order to keep the matter before the public mind but also to prepare the people for the promised legislation. This meeting was presided over by Mr. Bell, the Administrator of Dominica, who during the discussion admitted that I had "made out a good case for legislation." A similar resolution to that passed by the Legislature was then adopted by

the Agricultural Society, and a copy of it was subsequently forwarded to the Government. Such, then, is a brief account of what has been done in the Colony of the Leeward Islands towards the solution of the question, and I now bring the matter before this Conference. I understand, however, that there are Representatives here from Colonies in which legislation to control the mischievous effects of bush fires has been in force for years, and I hope that these gentlemen will bring forward facts to show the usefulness of such legal restraint.

In the West Indies and elsewhere in the tropics, under the generic term of Bush fires are included all those conflagrations, both great and small, whether caused purposely or accidentally, that destroy the vegetable products of the soil. They may be divided into five classes, as follows:—

1. The fires deliberately set to burn down plants growing on limited areas with the object of destroying blights that are troublesome or are likely to become epidemic.
2. The fires sometimes made to the windward of cultivated lands affected by insect blights, so that the dense smoke may kill or drive away the pest.
3. The "burns," when high forest is cut down, the trees lopped, and fire is used to destroy the immense encumbering mass of wood so as to render the ground sufficiently clear for cultivation.
4. The "grass fires" that are set in dry seasons to destroy dry rank grass in order to induce a new and tender undergrowth for the grazing ot cattle or for the grass-cutter's knife.
5. The ordinary "bush fires" of Dominica and other mountainous countries, by means of which the soil is cheaply and expeditiously cleared of brush and weeds, cut down or hoed up, on lands intended to be put into cultivation.

The first class of fires is simply a method adopted in the *treatment* of diseased plants, and is one of the heroic remedies of the plant physician when he endeavours to stamp out a dangerous epidemic. Such a remedy, however, is never used without careful precautions being taken to prevent unnecessary damage.

The second class of fires differ from the first in that the cultivated plants are not destroyed. The plan is frequently employed in some countries to rid plants of insect pests, which are readily killed by the acrid smoke of burning green wood, bush and leaves.

The third class of fires are seen only in forest clearings where they are made use of to remove the massive tangle of fallen trees that encumber the ground. In the early years of settlement in the West Indies, when the islands were covered with primeval forests, these "burns" as they used to be and still are called, were part of the systematic work of all planters. Laborie, in his

well-known work entitled *The Coffee Planter of Saint Domingo*, published in 1797, gives particular directions as to the proper way in which the forest trees should be felled, and the branches lopped and strewn, so as to get what he describes as a " good burn" that will clear the land sufficiently for commencing cultivation. It is worthy of remark, however, that even this far-seeing writer, who penned his words over a century ago, deplored the destruction of certain constituents of the soil by these fires, and said " it is to be wished that burning could be dispensed with." Forest burns are now to be seen only in Dominica, St. Lucia, Trinidad, Jamaica and other islands in which there are still tracts of virgin forest ; and, as such fires are essential and not fraught with dangerous consequences if due care be taken to prevent the conflagrations spreading, it is unnecessary further to consider them than to point out that legislation should not prohibit them, but should impose an obligation on the planter to prevent destruction of standing forest around the clearings.

The fourth class or grass fires, are frequently seen in all the islands, more especially in dry districts. As I shall later on have occasion to show, these fires—which often take place every dry season on the same ground—are disastrous in their ultimate effects, and the crop of fresh grass that springs up after them does not compensate for the evil worked.

The fifth class comprises the ordinary and well-known bush fires of the tropics. They are especially common in Dominica, and, in the dry season, they may be observed in that island in all directions. Indeed, not only the peasants but also many proprietors of large estates invariably employ this wasteful method of clearing land for cultivation. The advocates of the system say that the fire gets rid of the brush and weeds expeditiously and cheaply, and some say that it also does lasting good by destroying the harmful insects on the soil. It may be conceded at once that vegetable matter is removed most easily by fire, and if the removal of this matter were the only consideration no voice could be raised against bush fires. But a serious question has to be answered in the first instance, namely, is this vegetable matter in the form of leaves and brush of so little use to the land and the planter that its destruction is desirable? And, following on this question is the equally important one, does the planter gain or lose by converting all this organic material into inorganic matter in the form of ashes? Both these questions I hope to answer in such a way as to show that the clearing of land by fire is the worst and most wasteful system that the planter could adopt. I would pause here, however, to say a few words about the erroneous idea that, in consequence of fire having been passed over the land, there is likely to be a long immunity from the depredations of insects, for the reason that all of them have been destroyed in the burnt area. Now, most insects, like the higher animals in a state of nature, wander about in search of food. They are kept in check by natural laws, the chief of which

is the struggle for existence. And it is futile to expect that a circumscribed area can be kept free from insects by passing fire over it, for, as soon as fresh vegetation springs up on the burnt land, the insects will find it out and come in from all sides, so that in a short time the insect population of the patch will be as numerous as it was before the fire was set.

The harmful effects of these bush fires on the soil may be thus tabulated :—

1. They destroy nitrogenous matters that would have gone to enrich the soil by the natural decay of the brush and leaves.
2. They destroy a certain proportion of the nitrogenous matters already in the upper layers of the soil.
3. They destroy the nitrifying microbes in the upper layers of the soil.
4. They sterilise the upper layers of the soil, and thus for a time prevent the fixation of nitrogen for the use of vegetation.

It may be roundly asserted that in all cultivated soils in the West Indies there is a deficiency of nitrogenous constituents, which deficiency is usually attempted to be made up by the application of manures or by the digging in of plants, more especially those of the pea family grown on the land for the purpose. It is therefore most essential that the planter should do everything possible to add to his soil all the vegetable matter he can get hold of, so that by its decay it may increase the deficient nitrogenous constituents. And yet it is the custom in Dominica and elsewhere to destroy these most valuable organic materials by fire, instead of turning them into the land to repay the expense and labour of so doing over and over again by the resulting increased crops and finer produce. Indeed, as I have said elsewhere, "To prevent the peasant from destroying what is necessary for the fruitfulness of his land, is to do him good by ensuring larger crops from his holding. Thus it is advantageous to the country generally that this wasteful destruction by fire of important constituents of the soil should be put an end to." Agricultural chemists tell us that every pound of nitrogen in the soil has a definite value which may be expressed in figures. Were it possible to calculate the annual loss to planters on the basis of the money value of the nitrogen robbed from the soil annually by the bush fires, the total amount would be astounding.

But these bush fires not only destroy the vegetable matters intended by nature to enrich the soil, but they burn or bake the upper layers of the land, and this means that not only does the heat of the fire volatilize the nitrogenous matters already prepared in the soil for the assimilation of plants, but that it also destroys the nitrifying microbes that are constantly at work to produce the rich organic material for further plant food. Thus it seems that fires on lands, especially in these countries, are utterly disastrous

in many ways, that they cause a diminution of the quantity of the produce got from the soil, and therefore deleteriously affect the fortunes of the planters and consequently the prosperity of the country.

To prohibit these fires entirely would be to prevent peasants and others from destroying what is necessary for the fruitfulness of the land, and so it would be sound political economy. But political economy and "the liberty of the subject" are sometimes contradictory terms, as in this instance, in which a man is held to have as much right to destroy the fruitfulness of a certain portion of the land as he has to pull down his house. But he must confine the destruction to his own property and not injure his neighbour's. Were these bush fires always limited to the circumscribed areas being cleared for cultivation, there would be less to be said against them, and it is questionable whether in the present state of public opinion repressive legislation could be suggested with any chance of its adoption. But by carelessness, by ignorance and sometimes with malicious intent, the conflagrations spread over and ravage large tracts of land, thereby destroying much valuable property.

The devastation caused by bush fires in Dominica alone is enormous, and it is undoubtedly a serious drag on the prosperity of the island. During the dry seasons the fires may be seen in all directions along the coasts, in the valleys and on the hills. The absence of all control has rendered the people quite reckless in regard to them. If a peasant has to clear a few square yards of land to plant some "ground provisions," he will set fire to the dry brush in the afternoon and then gaily go home without troubling as to where the fire may run to. A fire set in this way in Dominica not very long ago near to the sea, spread to neighbouring lands and produced a conflagration that raged for days, running up a wide valley, destroying everything in its path and then reaching and seriously damaging cane and lime plantations on the hills. Dominica planters will tell the tale of how their cacao and other plantations have been greatly injured and the crops ruined by fires carelessly set in contiguous peasants' holdings; and they will tell also how their woodlands have been destroyed by similar fires. Indeed the losses due to these constantly recurring fires have become so great that legislation is urgently needed. If the matter were carefully inquired into, it would be found that, year by year, an increasing extent of land is being rendered barren by bush fires. As an illustration of the correctness of this statement I may bring forward the following facts concerning certain districts along the leeward coast of Dominica. Many years ago there were thriving coffee plantation on these lands, but now they are barren wastes of rocks covered in places with a thin skin of soil. During the wet season rank grass and weeds spring up from seeds dropped by birds or blown by the wind. Were the land left to itself, by the operation of natural laws soil would accumulate and seedling trees would grow and incease in number and variety, and, in a

comparatively short time in our West Indian climate, a "secondary forest" would result, and then, by the judicious felling of a portion of the wood, the land could be gradually brought back to cultivation. But what really happens is that most of these waste lands are subjected to the ravages of bush fires every year; the seedling trees are killed out and the soil is left burnt and bare, with no live roots ramifying in all directions to hold its particles together, so that, when heavy rains come, the loosened surface soil is washed to the valley or sea, and nothing but a rocky barren waste remains. This disastrous destruction of a cultivable soil has been going on for years and years in many islands in the West Indies, and it has resulted in the conversion of former fertile districts into barren wastes in Dominica, Montserrat, Antigua and all the islands to the north. It has not only made deserts where there should be gardens, but it has actually in places produced a disastrous effect on the climate. Mr. Watts can tell you of the evil effects of bush fires at the northern end of Montserrat and throughout Antigua. And I doubt not that many here can bear testimony to the fact that I have not over-estimated the urgency of the question.

In Dominica there is a dry barren district known as the Grand Savannah, and years ago the late Dr. Imray endeavoured to reclaim a portion of it by planting young Ceara rubber trees on it in all directions. The plants grew well and there was every hope that this barren waste would have been brought into remunerative cultivation and that a new industry would have been established in the country; but, unfortunately, the bush fires set by the peasants in the dry season swept over the plantation and killed out the rubber trees planted with so much care and expense. A similar attempt made later on to plant up portions of the Grand Savannah met with the same disappointing result, and it is clear that nothing can be done in Dominica to reclaim such barren lands until, by legislative enactments, the people are prevented from causing these extensive and disastrous conflagrations.

Legislation is also undoubtedly greatly needed in many of the other islands to abate the evils caused by these bush fires. It would not be advisable now to prohibit all fires on lands, but, without delay, an end should be put to the system whereby every person can at any time with impunity set fire to dry grass and brush and so produce a conflagration that may and often does cause great injury and loss to his neighbour's property, and that certainly retards the prosperity of the country. Although bush fires need not altogether be prohibited, they should not be allowed to be set in very dry seasons, as they are then exceedingly dangerous; and, at other times, they should be so regulated that the evils I have brought to your notice may be mitigated if not entirely abolished.—*Paper read before the West Indian Agricultural Conference.*

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Irregularity in the Growth of Teak.

BY R. S. HOLE, *F.C.H.*

IN a letter published in the August Number of the *Indian Forester* for 1897, "S. C." drew attention to the extraordinary irregularity in the growth of teak as exhibited by the rings counted on a large number of teak stumps. In the words of the author of that letter the peculiarity is that "the growth of the whole tree consisted of alternate cycles of normal and abnormally slow growth, each cycle (both of normal and abnormal growth) extending over a varying but generally considerable number of years." "S. C." goes on to enumerate the possible causes of this irregular growth, and says, "No. (1) (*i.e.*, damage by insects) may be left out of consideration altogether, the length of time over which the damage extends rendering it absolutely impossible that insects should be the cause . . . and it seems to me that in the majority of cases fire is the cause of most of it. My reasons for coming to this conclusion are as follows:—

(*a*) The suddenness with which the change from normal to very slow growth takes place.

(*b*) The very large proportion of trees exhibiting this appearance.

(*c*) The occurrence of 2, 3 or even 4 cycles of slow growth during the life of the tree."

The few observations which I have been able to make during the last three years regarding the life-history of the two defoliating insects, *Paliga damastesalis* and *Hyblæa puera*, both notorious teak pests, have convinced me that the peculiarity drawn attention to in the letter above referred to is, in many cases at all events, caused by these insects. The press of official work in unusually busy years of famine and working-plans preparation, with two transfers to boot, have prevented me from obtaining incontestable proof of this; but I think I have sufficient data to warrant my above assertion; sufficient, at all events, to show

that insect damage is at least as probable a solution of the problem as fire, and to make it desirable that more attention should be paid to the damage done by these insects in this connection.

The first point I wish to draw attention to is the very wide distribution of the insects mentioned. The first detailed account of them appeared to have been given by Lieutenant-Colonel Bingham in 1892, which is published in "Indian Museum Notes," Vol. III, No. 2, page 93. It is there stated that the plague of caterpillars which defoliates the teak occurs annually in some portion or other of the Rangoon Division of Burma, the destructive larvæ belonging to two species, *Paliga damastesalis* and *Hyblæa puera*, the former occurring in far the greater numbers. A reference to Mr. Stebbing's "Injurious Insects of Indian Forests," pp. 116 to 117, and again pp. 120 to 121 will show that *Hyblæa puera* has been reported in 1892 from the teak forests of the Hyderabad Assigned Districts; in 1893 again from Berar, from Dehra Dun, from the Kulsi plantation in Assam, and from the Pegu Circle of Burma, and that *Paliga damastesalis* has also been reported from Burma and Berar. In addition to this I would draw attention to an account published on pp. 126 to 129 of the *Forester* for April 1898, describing the attacks "of one or more species of caterpillars" in the teak plantations of Southern India at Nelambur, in Cochin and in Travancore. One of these was subsequently identified as *Hyblæa puera*, and it seems more than probable that it was accompanied by *Paliga damastesalis*. In an editorial note printed on page 517 of the *Forester* for 1900, *Hyblæa puera* is noted as attacking the forests of the Damoh Division, C.P., and in the same year I found the same insect attacking the forests in the adjoining Division of Jubbulpore. *Paliga damastesalis* is common in the Bombay Presidency, and I recently received a letter from the Divisional Officer, W. D., Kanara, in which he remarks that "the moth (*Paliga damastesalis*) is common here in Kanara always, especially when the teak is in leaf; sometimes so common as to injure every teak tree in Kanara, and I well remember one year when every teak tree from Kanara to the north of Thana district was badly attacked." In a letter published on page 325 of the *Forester* for 1897, Mr. R. C. Thompson reports that the teak forests in the Chanda Division, C.P., were defoliated by a small caterpillar in 1892, and that the same caterpillar defoliated the teak in the Damoh Division, C. P., in 1897. This insect has since been identified as *Paliga damastesalis*. I have found the same insect in the Damoh forests in 1898 and 1899, and in the Jubbulpore Division in 1899 and 1900. After reading some notes furnished by me in November 1898, regarding the life-history of *Paliga damastesalis*, Mr. Fernandez wrote: "I have no doubt now that the insect noticed by me in 1875 is one and the same as the *Paliga*," and on page 428 of the *Forester* for November 1898, Mr. Fernandez remarks, in connection with the same insect, that "the pest is spread all over the Central Provinces wherever you find

teak, and it certainly is more general than it was when I was here some years ago." It is therefore clear that both these insects have a very wide distribution, and that in all probability they occur wherever the teak grows throughout India and Burma. Hence it is quite possible that teak may be attacked by them in various localities over enormous tracts of country.

It also appears that one, if not both of these insects, has been known to attack teak in India for the last quarter of a century. From the notes collected by me also, it would seem that *Paliga damastesalis* (which, as a rule, appears to be far more numerous than *Hyblæa puera* in Burma, and which, of late years at all events, has been far more numerous than *Hyblæa puera* in the Central Provinces) is nearly always present on the teak trees, but that its attacks only do serious damage when the conditions are peculiarly favourable for its development, or when it is aided by *Hyblæa puera*. *There is therefore obviously nothing extra*ordinary in a teak tree being attacked by these insects two, three or even four times during its life.

The next point is, that the period of slow growth appears, from the rings on the teak stumps, to last for a considerable number of years, *i.e.*, for some ten to forty years. It is, however, obvious that these 10 to 40 rings may by no means represent the growth of 10 to 40 years, and the possibility of more than one ring being formed in a year does not appear to have been considered. It is, I think, generally believed that the defoliation of a tree, followed by the output of another flush of leaves, results in the formation of an extra ring of growth. Now the number of times a tree is defoliated in the year obviously depends on (*a*) the number of generations the attacking insect has during the year, and whether the conditions of the environment are generally favourable to its development or not; (*b*) the period during which the tree attacked usually remains in leaf, which in turn depends on the species of tree, the climate generally, and the character of the season in particular; and on (*c*) the vitality of the tree attacked and its ability to replace the leaves which are destroyed with fresh flushes of new foliage. *As far as my observations in the Central Provinces go, they have* shown that (1) the first attack of *Paliga* on teak in the year usually takes place in June-July, *i.e.*, when the first flush of leaves has fully developed, the majority of the trees being practically leafless in April-May; (2) *Paliga* hibernates in the larval stage, and hibernation commences from the middle to the end of October; (3) during this period from June to October, *Paliga* has three generations, each lasting about six weeks; (4) a teak tree which has been completely defoliated takes at least one month to renew its leaves, and that in consequence the same tree is not defoliated more than twice in the season, although the insect has three broods; (5) after the last attack, a weakly flush of small leaves is put out. In the Central Provinces, therefore, we may usually expect from two to three narrow rings to be formed during one year in the

wood of a tree which has been badly attacked by *Paliga* instead of one ring of normal growth. In the damp regions of Burma and Bombay, however, the teak obviously remains in leaf for a longer period than it does in the dry and severe climate of the Central Provinces. We should therefore naturally expect that the teak would be attacked earlier in the year in Burma than they are in the Central Provinces From the account given by Lieutenant-Colonel Bingham, already referred to above, and which is printed in "Indian Museum Notes," Vol. III, No. 2, p. 93, it appears that this is the case, the teak trees being attacked in the Rangoon Division in April 1892. Supposing that the time necessary for the insect to pass through one complete generation and that the period of its hibernation is the same as it is in the Central Provinces, there would nearly be five generations of the insect in one year in Burma, and supposing that the trees attacked take at least one month to renew their foliage, as many as four narrow rings could be formed in the period. It must, however, be considered that in a moist, mild climate (*a*) the hibernation of the insect may commence later and last for a shorter period, and (*b*) the teak trees attacked might have sufficient vitality to renew their leaves in less than a month. It is therefore not impossible for five or even six narrow rings to be formed in one year. We have, therefore, only to suppose that such attacks last for five years in succession, and we shall have accounted for 30 small rings on the teak stumps of "S. C."

My observations have shown that *Paliga* often has certainly three and very probably four generations in one year in the Central Provinces, and I believe that in more favourable localities it may have as many as five or six; and this insect is almost always present on teak in more or less considerable numbers. *Hyblæa* is known to frequently work in combination with *Paliga*, and it is believed to have at least two broods in the year. It is therefore clearly not difficult to imagine conditions being sufficiently favourable for the development of these insects to enable them singly or in combination to attack teak severely for four or five years in succession. It is also obvious that such favourable periods may be separated from each other by less favourable periods of varying duration. To show that severe attacks may be made for several years in succession, I will, however, remark that in 1897 *Paliga d.* was recorded as defoliating teak in the Damoh Division, C.P., three times during the year. In 1898 the same thing happened, and I was told by the inhabitants of the district that the same thing had happened for several years past. In 1899 I was unfortunately transferred from Damoh, but I believe that the teak were again attacked more or less severely. In 1900 the Damoh forests were severely attacked in July; this time principally by *Hyblæa*, and, from what happened in the adjoining Division of Jubbulpore, I believe that the second flush of leaves put out by the injured

teak was more or less severely attacked by *Paliga* in September-October of that year. It is therefore, I think, quite possible that teak may be defoliated several times in the year for several years in succession, and that from 10 to 40 small rings may be formed in the wood in consequence.

Finally, it is obvious that (*a*) the suddenness with which the change from normal to very slow growth takes place, and (*b*) the very large proportion of trees exhibiting this irregular growth would be fully accounted for by supposing the peculiarity in question to have been caused by insect attacks.

CAMP JUBBULPORE,
14*th* *April* 1901.

Insufficiency of the World's Timber Supply.*

(*Continued from p.* 366.)

12.—Bulgaria.

Bulgaria sits astride the Balkans, and might therefore be expected to possess vast forests: so she did for ages. But the last century or two have wrought such havoc that her supply no longer suffices for her needs. The excess of imports (see Table XXII) was as follows for 1898:—

	Kilogr.	*Francs.*
Imports	58,133,502	3,094 830
Exports	13,838,345	8,45,337
Excess Imports... ...	44,295,157	2,249,493

This excess import corresponds to a volume of 73,000 m.c. net, or 90,000 *m.c. in the forest.* It is a large amount for a population of small density and agricultural habits.

13.—Servia.

Servia is credited with 2,090,000 hectares of forest, or 42 per cent. of the total area of the country, which is 4,855,500 hectares. Either these forests are not yet opened up, or they are already ruined by abuse, for the official statistics show that the timber imports are in excess. See Table XXIII.

	C. metres.	*Francs.*
Imports	28,965	756,561
Exports	8,003	394,235
Excess imports ...	20,962	362,326

The excess imports are about equal to 35,000 cubic metres in the rough.

This is the last of the European timber-importing countries. They include the southern, western, and part of the central States. Their total area is 267 million hectares, and their population of 215 millions represents 57 per cent. of the total continental and island peoples. They comprise all the nations

* Translation by F. Gleadow, I.F.S., of "L'insuffisance de la production des bois d'œuvre dans le monde," par A. Melard, Inspecteur des Eaux et Forêts.

possessing the densest population, the most flourishing industries, the most active commerce, the greatest production of coal and iron ; in a word, all those which have been the seat of the oldest and most brilliant civilisations. The danger threatening them is evident, since the future of their commerce and manufactures alike is stringently dependent on the exporting countries. An examination of the resources of the latter will reveal the imminence of the danger.

14.—Austria-Hungary.

The total area of this country is 62,490,000 hectares, *viz*,—

Austria	30,020,000 hectares.
Hungary	28,220,000 „
Croatia-Sclavonia	4,250,000 „

The forests comprise 18,780,000 hectares, *viz*., —

Austria	9,710,000 hectares.
Hungary	7,540,000 „
Croatia-Sclavonia	1,530,000 „

Thus the whole empire has 30 per cent., Austria has 32·3 per cent., Hungary has 26·7 per cent., and Croatia-Sclavonia has 36 per cent. of their total surface under forests.

According to the census of 1890, the population of 41,358,000 comprises—

Austria	23,895,000 inhabitants.
Hungary	15,262,000 „
Croatia-Sclavonia	2,201,000 „

The amount of forest per head of population is thus : for the whole empire, 45 *ares* ; for Austria, 41 *ares*, for Hungary, 49 *ares* ; and for Croatia-Sclavonia, 69 *ares*.

This allowance, which is greater than that of France or Germany, provides Austria-Hungary with more than it at present needs, and thus allows of some timber export. The total annual production of timber and firewood is estimated as—

	C. metres.
Austria	27 500,000
Hungary and Croatia-Sclavonia ...	28,500,000

Of the Austrian share, as much as 47 hundredths of the total is timber. The fraction is a large one; but it must be remembered that 70 per cent. of the Austrian forests consist of conifers, and that half of the rest is high forest. Austria thus produces annually 12,900,000 cubic metres of timber. The proportion of timber in the Hungary-Croatia-Sclavonia production is not stated. An assumption that the whole is of the same quality as the forests of the State in the same region, which yield one-third timber and two-thirds fuel, gives an estimate rather above than below the truth, and leads to the result that Hungary and Croatia-Sclavonia together produce annually 9,500,000 cubic metres of timber. This amount is less than Austria obtains from a similar area, but the distribution of species in Hungary, &c., is less favourable, *viz*., oak, 0·27 ; beech and other broad leaf species, 0·52 ; conifers, 0·21.

The total timber yield of the Empire is thus 22,400,000 cubic metres, or 1·19 cubic metres per hectare. This is certainly a maximum estimate, for it is greater than the production of the French State forests, which produce 1·07 cubic metres after deduction of all unproductive areas, and greater than the total for all the Prussian forests which yield 0·81 cubic metres.

The timber imports and exports for the years 1888 and 1898 are as follows (see Tables XXIV and XXV):—

		Quintals.	Francs.
1888	Imports	963,367	5,885,399
	Exports	18,923,583	120,077,721
	Excess Exports	17,960,216	114,192,322
1898	Imports	1,724,122	5,659,809
	Exports	33,487,823	204,195,354
	Excess Exports	31,763,701	198,535,545

The "exports" have greatly increased, and the "excess exports" are 13,803,485 quintals more. Austria-Hungary has thus so far been equal to the demands made upon her by other nations, especially by Germany; but will she be able to keep up the supply permanently, or increase it? This is improbable. The exports seem to be nearing the maximum possible, unless, indeed, the whole producing capital or standing stock is to be destroyed regardless of the future.

The total timber production being estimated at 22,400,000 cubic metres, and the "standing" or "rough" contents equivalent to the excess exports for 1898 being put at 6,800,000 cubic metres (see Table XXVI), there remain 15,600,000 cubic metres for internal consumption.

For a population of 41,358,000 inhabitants this is a liberal allowance, which is perhaps capable of sparing a little more to add to the excess imports. It is nevertheless to be noted that England, with a slightly smaller population, has been obliged to import, on the last five-year average, some 15,000,000 cubic metres (forest measurement); and that Germany, in spite of its 14 million hectares of forest, imported in 1898 an overdraft of 9,000,000 cubic metres. Austria-Hungary can thus only be expected to increase or even maintain its exports on the condition that its commerce and manufactures remain stationary. The contrary is the case. Austria-Hungary is making great strides in all branches of economic activity. The industries of extraction, like those of chemistry and mechanism, have received a great impetus, the birth-rate has risen, and the population is fast increasing.

It would thus be a great error to imagine that the Austro-Hungarian forests constitute a great reserve for other nations to draw on. The reserve itself is in danger from the continued development of internal consumption. The higher prices offered and

the greater facilities of disposal may prove too much temptation for the virtue of many forest-owners to withstand, and the result will be a diminishing outturn in quality and quantity. These fears are endorsed by a very competent authority, *viz.*, M. de Bedö, formerly Director-General of the Hungarian forests. In his great work on the economic and commercial aspects of the Hungarian State forests, he says: " The State of Hungary possesses no " excess production such as can for long admit of an increasing " consumption; on the contrary, in many forests the available " supply stands in need of increase."

15.—NORWAY.

A nation of sailors, in constant sea communication with wood-demanding nations, has naturally for a long time been in the habit of calling upon its forests to provide an export trade. No vessel needed to leave empty, consequently the mercantile marine was fostered, and is now one of the finest in Europe. It amounts to 1,550,000 tons, which is equal to that of Germany, and half as much again as that of France.

Unfortunately, Norway has overdrawn its timber income and impoverished its forests. The total area is 32,296,800 hectares, of which 6,818,000 hectares are forest; that is to say, 21 per cent., a proportion far too small for a country two-thirds of which consists of rocks, swamps, moors, glaciers, &c. No legal check or limitation binds the private individuals who own 86 per cent. of all the forests. Even the communes are not obliged to have their forests properly controlled by the State Forest Administration.

The Norwegian timber exports are thus likely to be of much less importance in the near future. They are already less than is supposed, and notwithstanding the increased demand of the last ten years, the excess *in volume* of exports over imports has not increased. This is seen from the figures given below for the external timber trade for 1888 and 1898 (see Tables XXVII, XXVIII, XXIX and XXX):—

		Cub. metres.	*Francs.*
1888 ...	Imports ...	293,500	6,247,933
	Exports ...	1,802,837	43,469,579
	Excess Exports ...	1,509,387	37,221,646
1898 ...	Imports ...	369,000	7,966,296
	Exports ...	1,848,882	54,678,723
	Excess Exports ...	1,479,882	46,712,427

The 1898 excess exports, consisting for the most part of sawn timber, are about equal to 2,000,000 cubic metres in the rough. It is not the timber trade alone which is ruining the forests of Norway. For twenty years past another foe has been at work, *viz.*, the pulp industry. So long as useful timber alone was saleable, the harm was limited. All the large or serviceable trees were cut

out, but at least the little ones remained to renovate the forest in course of time. Now that the pulp industry takes small trees, there is simply nothing left standing. The following figures show the growing importance of this industry in Norway. In 1875 the exports were only 8,500 tons, worth 944,000 francs; in 1888, they already amounted to 162,455 tons, worth 12,738,000 francs; and in 1898 they reached 315,274 tons, worth 24,050,000 francs. The volume "in the rough" required for this production in 1898 may be placed at 1,400,000 cubic metres.

16.—Sweden.

The Swedish forests, covering 18,200,000 hectares, amount to 40 per cent. of the whole country. Being principally pine and spruce, they furnish valuable produce, possessing strength, lightness, and elasticity. The yield is fairly high, except in the extreme north and on the high mountains, where growth is slow. They seem to be in better condition than those of Norway, and the Government concerns itself with their preservation.

In the northern provinces a private owner may not cut for sale any tree smaller than 8 inches diameter at 5 feet above soil. It has been proposed to enact similar regulations for other provinces. Such a course would be true wisdom, for the riches of Sweden lie in its forests, which are the support alike of its industries and of its external commerce. Their disappearance, or even their impoverishment, would be a national disaster.

Sweden is, then, for the present, a fine reserve of forest produce; but it is to be feared that it will not be able in the future to provide any larger supplies than it at present spares. Still less can it be expected to make up the deficiency that will soon be the visible result of increasing demands by importing countries, and restricted output from Norway and Austria-Hungary. Neither must it be forgotten that, in spite of a steady stream of emigration, the population is increasing, and that in a country possessing a severe climate and little mineral fuel, the consumption of firewood is considerable.

The imports and exports of timber for 1888 and 1898 are as follows (see Tables XXXI, XXXII, XXXIII, and XXXIV):—

		Cubic metres.	*Francs.*
1888	Imports	32,827	976,926
	Exports	5,319,352	151,143,776
	Excess Exports	5,286,525	150,166,850
1898	Imports	177,404	4,706,854
	Exports	6,547,148	202,884,012
	Excess Exports	6,369,744	198,177,158

The volume "in the rough" of the excess exports for 1898 may be stated as 9,000,000 cubic metres. This enormous figure is still inferior to the annual requirements of the English market

alone, which demands no less than the equivalent of 15,000,000 cubic metres in the rough.

The pulp industry has also taken a great impetus in Sweden. The exports of this material, which were 38,473 tons in 1888, have risen to 181,474 tons in 1898, worth 21,574,000 francs.

The Norwegian pulp exports are mostly in the wet state. Those of Sweden, on the contrary, include a large proportion of dry pulp, so that, weight for weight, the Swedish pulp represents a higher value and a larger amount of wood. The volume in the rough representing Swedish exports for 1898, must be about 1,000,000 cubic metres.

17.—Finland.

The Grand Duchy of Finland, belonging to Russia since 1809, has hitherto possessed a separate administration. It therefore is treated separately, a course justified by the importance of its forests. The soil of Finland is composed of old primary rocks and granites, and forms a plateau on which are scattered lakes innumerable. The forests cover 22,500,000 hectares, or 60 per cent. of the total area of the country. It might be expected that the legitimate annual production of so large an area would suffice both for the needs of 2½ million inhabitants and for the export trade. Nothing of the sort. Local consumption for fencing, building, fuel, &c., reaches proportions unheard of elsewhere, unless perhaps in Canada. It is said that each inhabitant burns on the average 7 cubic metres annually. The export trade has been pushed so greedily, that the forests already show signs of reduction. Big trees are becoming scarce. In 1889, a "*standard*" of sawn stuff was obtained from $33\frac{9}{10}$ths logs. It now requires on the average 40 logs.*

Like most of the European forests, those of Finland have reached the stage when the cutting must be strictly limited to the amount annually produced by the soil, unless the wood capital itself is to be destroyed.

The exports of 1898 amounted to 3,315,389 cubic metres, worth 89,010,380 francs (see Table XXXV). The imports were insignificant, the volume is not stated, and the value was only 771,984 francs. The volume in the rough necessary to provide the exports is 4,500,000 cubic metres.

The pulp industry is as yet of less importance in Finland than in Sweden and Norway. Nevertheless the 1898 exports included 20,400 tons of pulp and 21,800 tons of millboard. In 1877 both these articles only amounted to 3,600 tons.

18.—Russia.

In 1897 Russia exported 146,239,495 francs worth of wood, being 144,233,100 francs for timber, and 2,006,395 francs for

* See the Report of M. Evensen, of the French Consulate at Helsingfors, dated 6th March 1899, in the *Moniteur officiel du Commerce* of 1st June 1899.

firewood (see Table XXXVI). In the same year the imports were worth 12,207,368 francs (see Table XXXVII. The figures for 1898 were not yet compiled). Russian statistics include "firewood" imports and "timber in the rough" under one head. It may be accepted that the imports and exports of firewood are equal, since the external trade in this material consists simply in the local exchange of produce between various points along the land frontiers. Accepting this guide, it is seen that the excess timber exports is equal to the difference of the total imports and exports, *viz.*, 146,239,495 less 12,207,368, or in round numbers 134,000,000 francs.

The customs returns only record the value; but it is possible to form some idea of the volume, because 87 per cent. of the Russian wood goes to Belgium, England, Germany and France, countries whose records contain information as to the quantities entered from Russia; thus:—

	Cubic metres.
Belgium	... 416,400
England (2,314,400 loads) ...	... 3,274,800
Germany (16,726 500 quintals) ...	... 2,787,700
France (496,300 tonnes) ...	... 827,100
Total	... 7,306,000

The Russian exports of timber for 1897 were thus at least 7,300,000 cubic metres, mostly cut up, and equivalent to 10,000,000 cubic metres in the rough.

It is very unlikely that the Russian forests can continue to bear such a drain. European Russia with Poland, but excluding Finland, does not appear to possess more than 160,000,000 hectares of forest, or 32 per cent. of the total area; Russia, 488,900,000; Poland, 12,700,000: total 501,600,000 hectares.

The percentage of forest is thus a little greater than in Austria-Hungary, but less than in Finland and Sweden. The distribution of the forests is very irregular; they are thick in the north, of moderate extent in the centre, and deficient in the south. The Russians are the most rapidly-increasing people of Europe. Under Peter the Great, in 1722, they were only 14 millions; at the end of the eighteenth century they were 36 millions; under Nicholas I. they were 65 millions, and the last census in 1897 showed them to be 103,600,000 (Russia, 92,200,000, Poland, 9,400,000). The consumption of wood is enormous. The country-houses are almost always wooden, and have to be often re-built on account of the frequency of conflagrations. River navigation is well developed, and requires a large number of boats. The climate is severe, and coal is only abundant in Poland and the south. This industry is still undeveloped; in 1897 the outturn of coal was only 10 million tons against 205 millions yielded by the English mines.

The timber demand is increasing more rapidly than the population; for Russia, once purely agricultural, is now becoming

strongly industrial. The progress in this direction is remarkable. For instance the production of cast-iron, 1861, 286,000 tons; 1881, 450,000 tons; 1897, 1,871,000 tons.

The forest production, on the other hand, far from increasing, has been diminished through the great havoc that has been wrought among the forests during the century. The forest area in the north is still large, but growth is very slow there; and it would be a great misfortune if overfelling should be allowed to destroy or injure the network of forests which modifies the polar winds. Russia is an immense plain, over 2,000 kilometres from the Arctic Ocean to the Black Sea, without a single sheltering chain of mountains. It is then of the utmost importance that the country should be traversed by great bands of forest, in order that the extremes of climate may be somewhat modified in favour of agriculture.

It is therefore to be expected that the Russian output will be influenced by two reducing causes, *viz.*, the increase of local consumption, and the extension of a due amount of care and conservancy over the existing forests. By the middle of the new century, fifty years only, Russia will have 150 million people, with immensely developed factories, mills, foundries, &c., of all sorts. By that time timber exports will have ceased, and Russia will be only too happy if precautious taken in time have succeeded in assuring a supply equal to her own wants.

19.—Roumania.

Out of 13,100,000 hectares, Roumania has about 1,800,000 under forest, or about 14 per cent. It is thus a poorly wooded country, and the present fact of its being an exporting country is only explainable by the sparseness of the population, which is under 5 millions. The imports and exports vary greatly from year to year, which shows that the forests are worked without any proper regulations, and gives cause for serious anxiety as to their future. This irregularity entrains the use of averages for comparison. From 1894 to 1898 (see Table XXXVIII), the timber imports averaged 22,638 cubic metres and 1,576 tons, worth 573,406 francs. The exports averaged 46,585 cubic metres and 48,000 tons, worth 5,112,524 francs. There was thus an excess export of 23,947 cubic metres and 46,424 tons, worth 4,539,118 francs. The excess exports may be considered equivalent to 120,000 cubic metres in the rough, a very small contribution to the huge deficits of England, Germany, &c.

20.—Bosnia and Herzegovina.

These provinces are well wooded; the total area is 5,100,000 hectares, of which 2,700,000 hectares or 53 per cent. is forest. Three-fourths of the forests are controlled by the State, for itself or for religious communities. An extent of 1,200,000 hectares has been leased to industrial or commercial companies. This is no

doubt an excellent way of getting an easy and immediate revenue out of forests; but it is very doubtful whether such a way is legitimate with regard to the maintenance of production and of the forest capital. According to the French Consul, the annual outturn is at present 1 million cask staves, 250,000 cubic metres of wood, in the rough, squared, or firewood, and 800,000 hectolitres of charcoal. Most of these things are exported.

North America.

Outside Europe, North America is the only place where vast and dense forests can be found economically exploitable, and capable of furnishing wood of all useful kinds at cheap rates. Canada and the United States therefore require examination.

21.—United States.

The forest area of the United States is not precisely known. It is supposed to be rather less than 200,000,000 hectares, a large figure by itself, but not at all large when compared with the extent of the Union; 200,000,000 out of 783,600,000 hectares, excluding Alaska and the Great Lakes, only works out to 25 per cent. or little more than Germany.

The destruction of forests, begun three hundred years ago, goes on unremittingly. Eminent men, fearful of the future destiny of a country denuded of forests, cry aloud in vain. Private and particular interests are stronger than everybody's business. The Union possesses hardly any forests between the Atlantic and the Mississippi, and private owners have every liberty and facility for plundering in a few years the stores that nature devoted so many careful centuries to produce.

In early days it was naturally necessary to clear and make room for the colonists, but now it is high time to see that clearing does not ruin them.

Between the Mississippi and the Pacific, the Union still possesses large public estates, but forests are too scarce, being almost entirely absent in the prairie States, scarce on the eastern slopes and on the plateau of the Rockies, and only become considerable in the north-west and on the Pacific slope. There they were and often are of great beauty, being full of conifers of unusual size. Unfortunately, the needs of colonisation, the unbridled abuses, excessive grazing, and fires, are exhausting and destroying them at a great rate. Their magnificence, far from being a protection, is fatally attractive to the speculator. In the west certain reserves have been constituted, and are not to be alienated. They cover 8,400,000 hectares, or a little over one per cent. of the total area of the States. However beneficial in *quality* their action may be, the area is so small that the *quantity* of this action can be barely perceptible. Europe thinks a great deal of these reserves. America is less optimist. It is instructive to read the report of the Committee which the National Academy of Sciences at Washington

sent to study them on the spot, dated 1st May 1897. Almost everywhere the Committee found depredations and damage from fire and pasturing. A few extracts may be interesting:—

(Page 17)—"With the exception of the National Park, whose boundaries are effectively and cheaply watched by detachments of the U. S. Army, your Committee was unable to find any indication of serious effort made by the Government to protect the public domain forests against illegal fellings and grazing, or to prevent or extinguish forest fires. An exception may be mentioned in the case of the northern end of the Cascade River in Oregon, where, in August, a single agent of the Department of the Interior was found actively and successfully employed in driving off several great flocks of sheep which had been devastating the reserve for weeks."

(Page 19)—"Signs of depredation were visible in all the reserves visited by your Committee. In the Pacific Reserve, Washington State, they were seen in the higher parts of the forest, forming a belt round Mount Rainier, a place much frequented in summer by tourists, who set fire to the conifers for the pleasure of seeing them blaze. This insane proceeding, which destroys in a few minutes trees which took centuries to grow, has greatly spoiled the foreground of one of the noblest landscapes in the States.

"The forest reserve of the Cascade chain has greatly suffered, from forest fires which have destroyed a great part of the best woods, and from sheep grazing which has been particularly excessive on the dry slopes of the north and east.

"The forest reserve of the Sierra is annually invaded by sheep, the numbers of which have so increased since their expulsion from the neighbouring National Park, that they now swarm up to the highest Alpine meadows."

(Page 20)—"In the grand Canyon reserve of Arizona, 2 or 3 square miles at one point near the edge of the Canyon, and one square mile at another point, have been enclosed by settlers in the last two years, or since the establishment of the reserve. Considerable quantities of wood are cut for local use, and mining establishments have been set up along the slopes of the Canyon. In the summer of 1895, the Howard Beef Company of Flagstaff pastured 5,000 sheep in this reserve.

"In the forest reserve of the White River plateau, in the north-west of Colorado, there is a saw-mill using wood cut in the reserve, and the whole of the timber used by another saw-mill further south, and by the town of Meeker, and by the settlers of the Upper White River valley, comes out of the reserve.

"The Pike's Peak, Plum Creek, and South Platte reserves have all suffered from terrible fires, which have destroyed the most valuable timber. What remains is freely taken by miners and railway contractors, and on the journey to the sources of the Colorado in Cripple Creek your Committee saw many railway

sleepers cut in the reserve openly stacked by the side of the high road. Among all the places visited, nowhere has your Committee found such contemptuous disregard for the rights of Government as in this region of the Colorado, and it is evident that under present conditions forests must speedily disappear from all the reserves of Colorado."

If such things exist in forests that are supposed to be protected against harm, what must be supposed to go on in the others?

Notwithstanding the manifest exhaustion of their forests, the United States continue to export; but they are simply dissipating their forest patrimony. M. Fernow, a very competent authority, states that even now the internal demand is sufficient to absorb the whole of the legitimate normal production of the forests.

The population of the United States, which was 63 millions in 1890, is increasing at the rate of 2 per cent. annually, and must be now 75 millions. This is not a great total, and in twenty years' time the people will certainly number 100 millions. As in the meantime the forest is sure to have diminished, it is certain that by then all timber export from the United States will have ceased, or will be compensated by imports from Canada.

The external trade in common timbers for the fiscal year July 1897 to June 1898, is as follows (see Tables XXXIX and XL):—

	Francs.
Imports	47,724,341
Exports	147,260,909
Excess Exports	99,536,568

The United States Customs do not state the quantities in many cases, so that any estimate of volume is impossible. It will be noticed that the imports are considerable. In certain States, near the Canadian boundary, the forests are already unequal to the demands of building and industry, and timber has to be imported. In the north-western and south-western States, on the other hand, the demand is less, the forests are less exhausted, and an export trade still exists.

22.—Canada.

The Canadian timber trade dates only from the beginning of the nineteenth century, when the ports of northern Europe were closed to England by the Continental blockade. Until then the forests had been almost untouched, for the population was scanty and almost confined to the banks of the St. Lawrence. The present situation is very different. For eighty years past immense destruction has gone on: sometimes for towns, villages, agriculture, &c.; at other times for pure loot without the slightest regard for reproduction. The Canadian forests consist mostly of conifers, in which wholesale fellings, made without leaving a sufficient

number of seed-bearers are simply ruinous. The forest is either destroyed outright, or, takes ages to recover.

Fires are also a serious cause of devastation in the forests of Canada. They are caused by the negligence of lumbermen, hunters and travellers, who go away leaving their camp fires burning; also by the farmers, who burn their lands or rubbish without taking any precaution to prevent the fire spreading. It is the case that the fires have destroyed more than even the lumberer's axe. Some of these fires have been immense. In his "Primer of Forestry," Gifford Pinchot describes the Miramichi fire of 1825: "It commenced its most destructive course at about 1 in the afternoon of the 7th October at a place 60 miles above the town of Newcastle on the Miramichi, in New Brunswick. Before ten that night it was 20 miles below Newcastle. In nine hours it had destroyed a piece of forest 80 miles long by 25 miles wide. Almost every living being on 1½ million acres was exterminated. Even the fish were found in heaps on the river banks. The towns of Newcastle, Chatham, Douglastown and others were destroyed, besides 590 scattered buildings: 170 persons and nearly 1,000 cattle perished."

In spite of what they have had to endure, the Canadian forests are still exceedingly rich. Their area, put at 323,000,000 hectares, is nearly 38 per cent of that of the whole Dominion. The distribution is very unequal. In the north, beyond the limit of tree growth, there is none. In the territories adjoining the Prairie States of the United States there is little. On the Pacific slopes and in British Columbia (75 per cent.), there is very much. The Atlantic provinces of Ontario, Quebec, New Brunswick, &c., are also well wooded.

It would be a great error to consider this great wealth inexhaustible. Up to the present, the finest, fastest-growing, and most magnificent forests have borne the brunt of the attack. Working northwards the crops will be found less and less rich, and the trees more and more stunted, till a limit is reached where the rigour of the climate forbids any encroachment by man. The destruction of the belt of northern forests, which now somewhat moderates the severity of Canadian winters, would cause the limit of vegetation, whether forest or farm, to be driven southward, practically diminishing by so much the habitable area. It must thus not be supposed that the whole of the Canadian forest area is covered with fine or even with workable forest.

The local consumption, estimated at 40 million cubic metres for 5 million people, is very heavy, besides which Canada contributes supplies to England, the United States, and many other places. Every year the trade is extending into the Far East, the Pacific, Australasia, &c., and Canada will be the only source of supply remaining to satisfy urgent demands when Austria-Hungary and Russia shall find themslves obliged to cease exporting. Canadian outlets are thus bound to increase rapidly

and if the present system of cutting all saleable trees, instead of limiting fellings to the annual production of regular areas is to continue, the wealth will rapidly disappear.

The *exports of timber for the year, July 1897* to June *1898*, were valued at 138,294,043 francs (see Table XLI). The statistics are too incomplete to permit any estimate of volume. The pulp industry is expanding vastly in Canada, the exports being as below:—

1890	...	...	...	...	415,000
1893	...	...	...	...	2,000,000
1897	...	...	...	...	3,845,000
1898	...	...	...	...	6,276,000

This progress is a threatening omen for the young and half-grown trees that would be left standing, if the demand for timber alone had to be met.

The imports of timber are small. In 1897-98 they were only worth 11,350,136 francs (see Table XLII). They consist partly of high-priced woods from the United States which are used for cabinet work, and can hardly be classed as common timbers.

The list of countries able to export timber is now ended. It may be judged incomplete, because it includes only Northern and Eastern Europe and North America; Asia, Africa, Central America, South America, Australia, being all left out.

It may be urged that these continents, hardly yet explored, contain vast forests, only awaiting the axe and capable of many centuries' supply. Such expectation would be a gross error, as is shown below.

23.—Asia.

Asia is a continent that has seen the *most ancient of all* civilisations be born, grown up, decline and disappear. Its soil is littered with ruins. From a forester's point of view it is not a new country but an used-up one almost everywhere. In Mussalman Asia (Turkey, Persia, Turkestan, Afghanistan, Arabia) deserts are alternated with steppes, and with naked mountains browsed bare by sheep and goats.

The celebrated forests of Lebanon, whence the Phœnicians drew their navies, have all but disappeared. The same is the case with the forests girdling the basins of the Tigris and Euphrates, which formerly supplied the great capitals of Nineveh, Babylon, Susa, &c. The fine forests that were quite recently to be found in the Caucasus, are now in great danger. There is so much hurry to cut them, that foreign contractors are called in. It were far wiser to leave them in peace for the local industries which cannot now long delay their appearance in the valleys below.

British India possesses hardly enough woods to supply its own 287 millions of people. Its forests would have already disappeared if Government for the last thirty years had not taken energetic measures towards conservancy. It can still export

70,000 to 80,000 cubic metres of teak, almost entirely from Burma (see Table XLIII), but this only amounts to the one hundred and fiftieth part of the British consumption.

In Indo-China it is also admittedly high time to stop the destruction.

China, with 380 jostling millions of people, has no forests of consequence. Up to the present, its timber imports have been small. In 1898 they were only worth 3,626,729 francs (see Table XLIV). But a great change is taking place. The Chinese Empire is being opened, if not to western civilisation, at least to western industrial processes. Railways and factories may already be seen. The soil contains vast coal resources which are now being brought under regular working. The time is at hand when China will bid for much wood in the world's markets. This will be obtained from British Columbia and the Western States of America, and China will in return contribute to the exhaustion of their forests.

Japan's 12 million hectares of forest may, if carefully husbanded, suffice for the needs of her 44 million people and their wonderfully progressing industries. But they cannot be considered as any resource for other countries that hunger for timber. Japan has 5 or 6 million people more than France, and it has been already shown that France with her 9½ million hectares of forest is yet obliged to buy 3 million cubic metres "rough" equivalent.

In 1897, Japan's imports were slightly larger than her exports (see Table XLV).

Imports	1,250,826
Exports	909,782
Excess Imports	341,044

Siberia possesses great forests, but not so much as might be supposed if the area, greater than all Europe, be compared with the population of 5,700,000 people. Part of Siberia lies outside the zone of tree growth, and another great part is occupied by vast grassy plains. It is principally in the southern mountainous regions that forests are found. They do not appear as yet to have provided any exports to Western Europe, and if such occur in the future, they are not likely to be large. Siberia is not favourably situated for sending common timber cheaply to England, France or Germany. Its rivers are frozen for months; they flow into the Arctic Ocean, which itself is not the most accessible of seas. Shippers might risk the length, cost, and danger of the voyage for some valuable mrechandize, but for woods there would be small inducement. Indeed, it may be supposed that the cost of transport would be so great, that the forest owner would find no profit. As to the Trans-Siberian Railway, its length between Lake Baikal and the Baltic is about 6,000 kilometres (3,600 miles). The actual cost of felling and carriage, without any allowance for

profit, *plus* the freight from the Baltic to England or France, would together amount to more than the timber would fetch when sold at destination. Besides, the opening of the railway will allow Siberia to become populous and to open up her immense mineral wealth. The local consumption of wood will become far more extensive than is foreseen at present. The railway will soon place Siberia in communication with the Gulf of Pechili, a much nearer market than Europe, so that any possible current of exported timber will flow surely east and south to China and Australia rather than west.

It is necessary to add that the extreme climate of Siberia imperatively dictates the maintenance of extensive forests, if the remainder of the country is to remain habitable. It is to be supposed that the Russian Government will have the wisdom to veto all attempts at mere plundering of its great Asiatic possession.

(*To be continued.*)

A Visit to the Earl of Yarborough's Woods.

By E. Mc'A. Moir.

The extensive woods of the Earl of Yarborough occupy the northern part of the wolds of Lincolnshire, and constitute an important feature in the scenery of this part of England. The Lincolnshire wolds, or range of low chalky hills on which the woods are situate, consist of an undulating series of chalk hills belonging to the Lias formation, and are a continuation of the more important Yorkshire wolds extending across the Humber river into Lincolnshire for a distance of about 60 miles. The soil is generally dry, but in good many places the chalk is covered with a sandy loam with occasional beds of clay of medium thickness and good quality.

The height of the Lincolnshire wolds varies from 200 to 800 feet above sea-level, the highest point being at Pelham's pillar situated in the middle of the Brocklesby woods, and which constitutes an important landmark to the surrounding country.

The Brocklesby and Manby woods include the main portion of the Earl of Yarborough's forest estate, and cover an area of nearly 5,000 acres, besides which there is an extensive wooded part kept for ornament, and in the middle of which Brocklesby manor, the family seat of the Earl of Yarborough is situate. The total area of the Earl's property in Lincolnshire amounts to about 50,000 acres, so that the forest area representing 10 per cent. of the whole, may be considered a fair proportion under wood, in comparison to most other English properties, where the percentage is generally much lower.

The Earl's woods are in charge of Mr. W. B. Havelock, trained forester, a gentleman of great practical experience in

sylviculture, and who conducted the undersigned and Mr. Fisher through the woods, and took the greatest pains to explain all matters of interest to us in an intelligent and careful manner.

The planting of the Brocklesby woods on the Lincolnshire wolds was commenced by the first Earl of Yarborough in the year 1787, and up to the end of the year 1823 no less than 12,552,000 trees, consisting principally of oak, ash, larch, beech, Scotch fir, elm, &c., had been planted in a systematic and careful manner.

In order to commemorate the event a solid freestone pillar about 120 feet high was erected on the highest point in the middle of the woods with a record of the planting work inscribed thereon. A detailed record of the area and number of trees planted from the commencement of these operations has been carefully kept, and up to the end of the year 1899 a total number of 21,346,500 trees of all kinds have been planted out.

The only years during this long period in which no planting work was done, were the years 1881, 1882 and 1883, when for financial and other reasons the work was temporarily discontinued, but since that time it has gone on regularly.

The maximum number of trees planted in any one year was 6,58,890, and the average number planted during the last twelve years was 190,500; the largest proportion of which was larch, this being the most useful tree to grow. In 1887, many of the old woods planted during the last century had become mature, and owing to the early thinning out of larch from fear of disease attacking it, most of these woods were considered too thin to stand any longer, so the plan of clearing 50 acres per annum, and re-planting the area was commenced, and regularly carried into effect, year by year, ever since.

The system adopted in the formation of these woods consisted in the planting of broad strips, commencing in the most sheltered places; the trees being planted 5 feet × 4 feet apart. All plantations were fenced by means of live hedges, or by posts and rails, or wire fences, and the planted area was carefully intersected by broad grass glades or rides, which form quite a marked feature of these woods.

It should be noted that in this case the main object of these broad lines is not fire conservancy, as forest fires are of rare occurrence; but principally to allow free passage and galloping space for fox-hunting, which pursuit forms quite an important portion of some men's business in this part of England.

The maintenance of these glades in proper hunting condition, and the providing of suitable cover for the numerous foxes, have therefore to be carefully considered in conducting forest operations on this estate.

From the records of planting work, and the inspection of the forests, it appears that larch and ash are the two most important

species cultivated in the Brocklesby woods, and by far the most satisfactory growth is that of ash, which species does remarkably well in some parts of these plantations.

The ash tree often attains a girth of 6 feet in a hundred years, and the timber is much appreciated in the London market as being exceptionally tough and superior in quality.

At the local auction sales first-class ash timber sells at rates varying from 2*s.* to 2*s.* and 4*d.* per cubic foot, and poles at 1*s.* per cubic foot, and even small pegs for stack thatching purposes fetch 1*s.* 3*d.* per bundle of 120, and are always in demand.

Large-sized well grown ash trees are numerous in certain parts of those woods, and we examined one tree growing on the avenue between the Hall and the family mausoleum, 7 feet in girth, with a clean bole of 50 feet, and which was said to be about hundred years old. Ash is probably at present the most valuable of the European forest trees, and is supposed to thrive only in special localities, such as on alluvial land near river banks, or in damp ravines, and not on chalk or limestone hills.

We found the ash trees specially flourishing in a wood about fifty years old, from which the larch had been cut; and in some other plantations we noticed a very good natural regeneration of the species from suckers, which were not, however, being encouraged as much as they might have been, many of the best stems of shoots having been cut down injudiciously when cleaning operations were last undertaken.

Sycamore also thrives well in the Brocklesby woods, and we measured one of a group 14 feet in girth and with a good bole, 30 feet long. The timber, however, fetches a much less price than ash, *viz.*, from 1*s.* to 1*s.* 4*d.* per cubic foot only.

The larch we saw at the Brocklesby woods is generally vigorous and healthy at least up to the age of fifty years, and one we saw near the Hall measured 8 feet 8 inches in girth, was about 100 feet high and must have been nearly a hundred years old.

In some of the plantations, however, where the soil is too stiff, we noticed unmistakeable signs of disease, but fortunately in these places there was a fine stock of hardwood trees to take its place when cut out about the age of fifty or sixty years. Larch timber at the annual sale fetches from 1*s.* to 1*s.* 6*d.* per cubic foot.

The principal new plantation examined by us was one called the Jubilee plantation, which was formed in 1897 in commemoration of the late Queen Victoria's Jubilee year.

This plantation occupies the site of some old-abandoned fields, and is situated partly in a hollow and partly on sloping ground well up near the top of the wolds.

It is rectangular in shape and comprises an area of about 42 acres, and is surrounded partly by cultivation and partly by other plantations.

The soil, over about ¾ of the area, especially in the *hollow part, consists* of sandy loam, and in the remainder it is of a light chalky nature.

The main reason why the site was abandoned for agri*cultural* purposes was that it always had the reputation of "drying up," even after a moderate drought, so that the place was not very favourable for plantation operations, as subsequent events have shown.

It having been decided to fence the plantation by means of live hedges of hawthorn, a belt or ride 6 yards wide between the plantation and the hedges was left, so that when the trees grow up they may not overshadow and suppress the hedge.

Two straight rides, 8 yards wide, running from north to south, were also laid out across the plantation, and these are intersected by another broad line running at right angles, from east to west, so that the whole area is divided up into six compartments of about 6 acres each.

The acreage taken up by the ride, *viz.*, 6 acres, seem to be rather out of proportion to the remaining area planted, but Mr. Havelock explained that arrangements for facilitating for hunting being an important consideration in the formation of these woods, the construction of broad lines or rides with this object in view has to receive special attention.

As the plantation during its early stage was certain to be liable to injury from rabbits, it has been surrounded by 3½ feet wire netting, 6 inches of which is let into the ground so as to prevent the rabbits from burrowing underneath.

The planting material consisted of the following species, *viz.*, larch, ash, beech, sycamore, oak, Scotch fir, spruce, Austrian pine, &c. The trees were planted in lines 4 feet apart; the plants in the lines being situated 3 feet apart, so that 2,722 plants were used per acre.

Pits were not dug, but the trees were simply notched in with the spade, the planting work being done during November and December, which are the two best months for planting in the wolds.

As the larch is the most profitable species to cultivate for general use on a large scale, and as it reaches saleable dimension sooner than the ash, about ⅔ of the plants used were of this species, the other kinds being planted in about equal proportion.

All the plants used for this plantation were grown in the local nurseries, but some of them had to be carried 20 miles by means of carts. The total number of trees at first planted out was 1,02,000, and the original cost of the plantation, not including fencing and supervision, amounted to £172, *i.e.*, £4 2*s.*, or about Rs.60 per acre.

Up till July 1898 all the plants did well, but during that month a severe drought took place which destroyed a large number of the trees; the larch having suffered most, the Scotch fir, ash and beech having stood better.

This necessitated the renewal of 43,600 trees during the following November and December, Scotch fir and beech being mainly planted and the extra cost of the operation amounted to £68.

The total cost of the plantation therefore amounted to £241 or about £5 15s. per acre.

As stated above, this did not include the cost of fencing and supervision which may be put down at £2 5s. per acre, so that the total cost of the plantation probably amouted to about £8 or Rs.122 per acre.

All the plants are now fairly well established, and the plantation is doing well, considering the unfavourable nature of the soil and adverse climatic conditions. After the Jubilee plantation we visited two other adjoining plantations of fifteen and twenty years of age respectively.

These consisted mainly of larch, sycamore, ash, oak, &c., and judicious thinnings had been lately made, *i.e.*, only the dead and dying trees had been removed in a careful manner, and the result of the operation seemed to be most satisfactory.

The height of the trees in these plantations averaged 25 to 30 feet respectively, the larch being 16 inches in girth and the oak 23 inches in circumference. Nearly all the sycamore were holding their own very well, and promised eventually along with the ash and oaks to produce a good crop when the plantations reach their exploitable age at hundred years.

The larch poles after being creosoted meet with a ready sale at 50s. per 100, or are sawn up and used for fencing, and the other thinnings are sold for fuel, for which there is a considerable local demand.

A good deal of self-sown birch trees was observed in the plantation which were about to be removed, for if left they would soon choke out the hardwoods.

Various other plantations of a similar nature were visited by us, where we observed that the planting, thinning and cleaning operations had been carried out in a careful and very intelligent manner.

The rotation of the Brocklesby woods being fixed at about hundred years, Mr. Fisher considers it hardly worth while planting oak in an extensive scale, as it is liable to be suppressed by the more rapid growing and more useful larch, and as it cannot attain fair dimension at hundred years, the planting of oak should be confined principally to the park, where it is wanted mainly for ornamental purposes.

From the above account it may be concluded, that the management of the Earl of Yarborough's woods is being conducted in an intelligent and practical manner, and consists in the rearing

of mixed woods of larch, ash, oak, Scotch fir, &c., up to the age of hundred years, when areas of about 50 acres are annually cut and re-planted.

The annual revenue from the Earl's woods during recent years is said to vary from £5,000 to £6,000 per annum, and the expenditure amounting to about £2,500, the net revenue probably amounts to about £2,500 or 10*s*. per acre per annum. As regards the experimental cultivation of exotic trees, we examined a fine Pinetum in which we saw some good specimens of the following species, most of which were planted about sixty years ago. *Sequoia gigantea*, *Picea orientalis*, 71 feet high and aged about sixty years old. Also *Pinus cembra*, *Carya alba*, *Juglans nigra*, *Picea morinda*, cedar of Lebanon, Deodar, Douglas pine, &c., all of which exhibited for their age very respectable dimensions.

In another part of the woods near the family mausoluem, there is a fine grove of cedar of Lebanon, aged about hundred years, some of which have attained 15 feet in girth and 80 feet in height and which are flourishing, though some had been damaged by wind. The picturesque character of the broad rides or glades through the Brocklesby woods, is maintained by lopping half through, and then binding and pegging down the numerous Portugal laurels which border them in many places, the crowns of which soon take root in the rich humus, and they thus form an evergreen edging to the sides of the rides, and at the same time form good cover for the foxes and other game.

As regards the plague of rabbits in the young plantation, which is such a fruitful source of tribulation in all European planting works, they are of course kept well in hand by the foxes, also by the extensive use of the wire-fencing already referred to; and it may be noted that it is now fairly well established, that, as in the case of rabbits in Australia, the home rabbits also are developing, jumping or rather climbing powers, so that it not unfrequently happens that after all the trouble and expense incurred on fencing the young plantations, a certain number of the most energetic rodents manage to get inside by climbing over the fences.

II. CORRESPONDENCE

VI.—EXTRACTS, NOTES AND QUERIES.

Insect attacks on Terminalia Chebula.

THE myrobalans of *Terminalia chebula*, commonly called *harra*, being one of the most important minor forest products of this Division, this tree receives considerable attention; and the time of its flowering and fruiting and the development of its fruit are duly noted. Last season the harra crop was practically a total failure, and this was caused by (1) the depredations of a defoliating caterpillar, and by (2) the attacks of a gall insect.

In July, 1900, harra, together with several other trees including teak, *Anogeissus latifolia*, *Adina cordifolia* and *Stephegyne parvifolia*, were absolutely defoliated. I was unfortunately unable to leave headquarters at the time, and I did not succeed in getting specimens of the attacking larvæ from the harra trees themselves. Simultaneously with this defoliation in the district, however, an equally severe attack was made on the various garden and avenue trees in Jubbulpore itself. Larvæ clustered on the trees in enormous numbers and teak, *Millingtonia hortensis* and *Albizzia Lebbek* were, among others, completely defoliated. I collected several of these larvæ and the moth which emerged from them proved to be *Hyblæa puera*. At the same time as this occurred, the forests in the neighbouring district of Damoh were also attacked by a defoliating caterpillar, and specimens of the insect collected by the Divisional Officer were subsequently also identified as *Hyblœa puera*. I am therefore inclined to think that this insect is also the culprit in the case of the damage done to harra.

In consequence of this wholesale destruction of foliage, the teak and harra trees were practically devoid of flower and fruit, and the majority of the harra flower which was produced never developed on account of the attacks of a gall insect. In September, 1900, I noticed that the flowering spikes of many

harra trees were covered with round bodies of a dark-red colour, bearing a superficial resemblance to the fruit of a species of small fig. It appeared that the flowers instead of developing into the usual myrobalans had, owing to the attack of a cynipid insect, merely produced these small galls.

Specimens of the galls were sent by me to the Indian Museum for identification in October, 1900. The insects which emerged from the galls were pronounced to be chalcids, and were forwarded by the Museum authorities to Mons. André, France, for identification. Mons. André, however, has been unable to do more than identify the insects as chalcids, and he surmises that they are parasitic on the cynipids which produce the galls. If this surmise is correct, and nothing but chalcids emerged from the considerable number of galls sent by me, it appears that the gall insect is subject to very widespread parasitic attacks in face of which it can scarcely develop to any extent or do any considerable damage. There appears, however, to be a possibility that the chalcids themselves are primarily responsible for the formation of the galls, and it is hoped that further observations and the collection of additional specimens will settle this point which is of considerable importance in harra-producing tracts.

JUBBULPORE:
18th April, 1901.

R. S. HOLE,
Divisional Forest Officer.

Flowering and Seeding of Manwell Bamboos (Dendrocalamus strictus) in the Central Thana Division, Bombay Presidency.

THIS bamboo known as Manwell all over the Thana district flowered in the Mokhada Hills, which form the western projection of the Ghats over an area of about 3 square miles in the reserved forests of the village of Assa, in December, 1900 and January, 1901, and the seeding occurred in March. The flowering was not entirely gregarious, but very nearly so, and was confined to the mature clumps. A clump here and there seemed to escape.

In the Wada Range, which is in the central portion of the district, I observed the flowering was sporadic and scanty.

In the Bassein Range on the Sea Coast, the flowering was a little more copious than in Wada, but not gregarious. I am informed that at Yewa, a village in the Kalyan Taluka of South Thana, the Manwell bamboo planted in the village also flowered this (1901) season, and that about half-a-dozen clumps in the forests close by flowered as well. In these cases the flowering was not confined, it is said, to the mature clumps only, but also to the younger ones. In 1899, I met with a solitary clump of the same species in seed in the Bhiwandi Range of the South Thana Forest Division.

IDENTIFICATION.

Specimens of the flower and leaves of the bamboo were despatched to the Superintendent, Calcuttta Botanical Gardens, who identified the species as *Dendrocalamus strictus.*

METHOD OF COLLECTION OF SEED.

While in the Assa Forest, in March 1901, I found the wild tribes gathering the bamboo seed for home consumption, and also for sale in the neighbouring native State of Jawhar. The outer culms of each clump are cut one by one at about 4 feet from the ground, and each culm bearing seeds is laid on the ground, which has been previously cleared and swept. The culm is well beaten with a stout stick till all the seeds from it have fallen.

The fallen seeds with husks are carefully collected and winnowed by children. It appears that on being taken home, the seeds are crushed in a mortar. One adult is said to be able to collect 2 to 3 seers, *i.e.*, 4 to 6 lbs. of seed per diem. Seed was also collected and sold in the Jawhar State (which is adjacent to the Assa Forest) at Re.1 per 16 adholies, *i.e.*, 64lbs. I have a few pounds available for distribution if required.

G. M. RYAN.

The Flowering of the Bamboo in Travancore.

AT a time when the flowering of bamboo is observed in other parts of India, it may be of interest to learn that a few clumps of the common bamboo of Travancore (*Bambusa arundinacea*) which the natives of the country call *ola mula*, or *olay mungil*, are flowering here and there. It is generally supposed that this phenomenon is the precursor of a general seeding of the species.

About this time in the year 1876 there was a general seeding of this class of bamboo in the country and an utter destruction of it. In all likelihood there may be a general flowering next year.

T. PONNAMBALAM PILLAI.

Dipsas forstenii.

IN Blandford's edition of *Boulenger's Reptilia* and *Batrachia*, this snake is not recorded as occurring in Burma.

I took a specimen on the 16th of March in the Toungoo district, and wish to put the same on record.

It is a powerful and fierce snake and can distend its throat after the manner of certain lizzards when angry. But as this distention can only be seen to advantage from the side, I am at a loss to account for its object. The compressed body shows it to be more or less a tree-snake, and the specimen I took had swallowed a partially fledged bird about the size of a mina.

The snake is probably rare in Burma, as I have no native of the province who has yet recognized it.

JAS. D. HAMILTON.

Forestry in Great Britain.

It is probably known to most people that for the supply of our requirements in the matter of timber, as in that of food-stuffs, we depend largely upon imports from abroad. But it may be doubted if many beyond the comparatively few who have given special attention to the subject have realized the fact that the annual cost to the country of these imports amounts to somewhere about twenty-five millions of pounds. It has been often urged that it would be worth some trouble to prevent this large sum, or a portion of it, going out of the country, and it has been pointed out that a proper system of forest management would bring about this result. Of course, so long as the foreign supply is ample, and the price of imported timber is less than that at which it is profitably produced at home, our markets will continue to absorb foreign produce as heretofore; but these conditions which have hitherto prevailed are, in the opinion of experts, not likely to continue. For some years past, this and cognate questions have attracted considerable attention, as witness the writings of recent date noted below,* all of which are deserving of careful perusal. The burden of all of them may be summed up in the phrase cited by a writer in the *Times* of March 17th, 1899: "Cotton," it is said on the other side of the Atlantic, "was once called King; but King Cotton is a lesser potentate than King Timber must soon become." In other words, the world's demand for timber in outrunning the supply under present methods, and an appreciation of timber values is therefore setting in, which is likely to be permanent and progressive. Cheap timber is probably a thing of the past in this country. To some such a declaration will only appeal as the old cry of "wolf," and they may argue that any scarcity of timber will be balanced by the substitution for it, in many cases, of other suitable products; and such substitution has, no doubt, in the past taken place; as for example, in ship-building. But it must be remembered, that facility of transport has by now led to inroads into the world's timber capital in practically every timber-producing region, and the ruthless destruction of virgin forest without attempt at regeneration has brought us now within measurable distance of the end of the natural supply; and further, in recent years, the applications of timber to other purposes than those of construction; as for example, in the manufacture of wood-pulp, have made it an efficient substitute for other products, and thus the demands for it have been multiplied and may be yet increased.

* "Forest Management with Suggestions for the Economic Treatment of Woodlands in the British Isles" (*Trans.* Surveyor's Inst, 1900); "Canadian Trade with Great Britain (*Contemp. Review*, January, 1900); British Forestry and its Prospects" (*Trans.* Roy. Scot. Arbor. Soc., Vol. XIV, Part II, 1900); "Deficient Production of Timber in the World" (*Trans.* Eng. Arbor. Soc., Vol. IV, Part III, 1900); "Outlook for the World's Timber Supply." Report of lecture by Dr. W. Schlich (*Journal* of Society of Arts, March 1.).

In these circumstances, then, not from any sentimental ideas connected with the growing of timber at home, but from the standpoint of business principles, the question of the growing of timber in Great Britain to an extent which shall in some measure make us less dependent upon foreign supply, is one which has now assumed practical importance.

That wood can be profitably grown in Great Britain, even under the unscientific methods now in operation, has been amply proved; that under a system of scientific management crops of timber could be raised to yield a certain and adequate return upon capital is demonstrable. What lies at the bottom of the absence of such crops in this country is want of appreciation, from land-owners down to the working forester, of the right principles upon which they can be grown. There is, speaking generally, no practice of scientific forestry in Great Britain. Other immediate causes there are which have contributed more or less to the neglect of scentific forestry in Britain, for instance, tenure of land, the claims of sport—this probably one of the most influential factors—the rating of woods, and so forth. These are obstacles, and no doubt will remain so, in the way of tree-planting; but assuredly were our landed proprietors, land agents and foresters better instructed in the methods of growing timber and in the possibilities of remunerative crops, less would be heard of them as such. It is difficult to instil into those who have been brought up in other traditions the fact that trees which are to yield a crop of timber must be grown under rules as definite as those which govern the cultivation of ordinary agricultural crops, because the time which is required for the maturation of the crop and the securing of the final yield exceeds the lifetime of the individual. Yet it can only be when this fundamental fact has been realized that a supply of marketable home-grown timber will be available in Great Britain.

These are not, it is gratifying to note, wanting indications that already some proprietors, even the Government, are appreciating the necessity and the advantage of cultivating their woods upon rational lines. Working-plans for the economical management of woods have been prepared and adopted upon estates of the Earl of Selborne in Hampshire—of which an account will be found in the Transactions of the Royal Scottish Arboricultural Society already cited—of the Duke of Bedford at Woburn, of Mr. Munro Ferguson at Raith and Novar, and in the Forest of Dean the Government has similarly arranged a working-plan. These working-plans, which are a novelty in the country, are worthy of study by those who own woodlands, for they indicate the method which ought to be followed upon every estate where it is desired to grow wood for profit. Hitherto proprietors who may have desired to cultivate their woods on scientific principles may have met with the difficulty of obtaining expert advice; but such a difficulty no longer exists, for there are in

this country now retired forest officers of the Indian service, to whom proprietors may readily go for sound and safe guidance. At the same time we cannot hope that the cultivation of crops of timber in this country will attain the dimensions which it must do if it is to affect to an appreciable extent the market supply of timber until means for the acquisition of knowledge of scientific principles underlying it are available to those to whom woods belong and to those who have the direct management of the woods. Within the last decade several trustworthy text-books upon forestry have appeared, but our only school for instruction in forestry at the present time is that of Cooper's Hill. Cooper's Hill is, however, open only to entrants to the Indian Forest Service, and there is no institution in the country to which any one desiring a thorough acquaintance with the principles of forestry can go. Our Universities are now alive to the claims of agriculture as a subject of study, and agricultural colleges are being formed in different districts. How long will it be before the Universities recognize that forestry also is worthy of attention, or the agricultural colleges take up the subject in their curricula? It is matter of common knowledge that a committee appointed by the Secretary of State for India recently reported in favour of the transference to Cambridge of the forest school from Cooper's Hill. As yet, however, no action has been taken upon the recommendation. The Secretary of State may rest assured that such a transference would be a reform meeting with the hearty approval of men of science, and the presence at Cambridge of such a school would give an opportunity to under-graduates connected with the landed interest to obtain some acquaintance with a subject of intimate concern to them. The influence of this upon the prosperity of the country would ultimately be most beneficial. As has been said above, ignorance is the real cause of our present condition as a wood-growing country, and until systematic instruction is provided in some of our Universities or colleges, there will be no great reformation in forestry practice, although there may be amelioration through the action of intelligent and far-seeing individual proprietors.

NATURE.

Perfume-plants. *

THE most profitable articles to export for long distances, such as from India to England, are those which contain much value in little space; perfumes for instance.

The orange flower is the one most certain to be profitable. Orange-flower-water is only *produced*, at Nice, Cannes, Grasse, &c., to the extent of 465,000 litres (one litre = $1\frac{3}{4}$ pints); whereas the *exportation* of that article amounts to more than 1,000,000 litres, not including the amount used in France. Over 500,000 litres have thus to be concocted from leaves, and the result is a very inferior product neither desired by the consumer nor fit for the uses made of it. Paris alone imports 5 million francs worth of scented oils, fats, and essences. All France not improbably imports 12 millions worth.

It will be as well here to explain what kind of substances these are, and to note a few of the plants most useful for the purpose. (Mostly those found in India as well as in New Caledonia are here included.)

There are several ways of extracting perfume from flowers; for instance, the pneumatic method, the ether method, the sulphide of carbon method, &c. These methods require special machinery, and are suitable for regular manufacturers. Those who wish to work them are referred to special works on the subject. There are three other methods which are capable of profitable use, namely, '*enfleurage*' (cold absorption), *warm maceration*, and *distillation*.

Enfleurage.—Formerly, oil of Ben † was considered the oil *par excellence* for perfumery, because of its great affinity for volatile perfumes, and especially because it does not soon become rancid. It has now almost disappeared from the French market, because of its high price and the heavy duties payable on its importation. It is replaced by fine olive oil; but, if obtainable, its use assures a real superiority and consequent greater profit. It would be easy in this country to extract the oil by means of a simple form of oil-press, the seeds being collected from the nearest trees. [The commonest native name is '*soanjra*' (horse-radish tree), the long pods when green are cooked and eaten, the flowers and roots also.—*Transl.*]

The process is quite easy. Pieces of flannel or coarse cotton cloth are soaked in the oil and spread on frames of wire. These frames with cloth are piled one on another with a layer of flowers between each. So they remain for 50 or 60 hours till the flowers have lost all their perfume. Fresh flowers are then

* Abridged (and adapted to India) from Dr. E. HECKEL in "the Revue des Cultures Coloniales," by F. GLEADOW, I.F.S. The perfume industry is easy to work, requires little machinery, and seems likely to repay enterprise.

† This is stated to be *Moringa pterygosperma*, whose "nuts" (? seeds) yield about 25 per cent. of their weight of an excellent oil able to absorb from flowers certain perfumes which are destroyed by heat.

substituted until the cloth has acquired a strong odour. The oil is then extracted from the cloths by heavy pressure. The frames may even be dispensed with, the layers of cloth and flowers being simply piled one on another.

Warm maceration.—This process is almost as simple, and anyone can work it at small cost. Take a few pounds of lard or other animal fat, melt it in boiling water in a very clean vessel. Let it cool so that all impurities fall to the bottom of the water. The grease will solidify in a cake on top. Take it carefully out, and if it retains the slightest smell repeat the operation with fresh water and a pinch of salt or alum. When a perfectly odorless cake is obtained, drain it well and melt it over a sandbath, or in a vessel surrounded by hot water. Raise the heat and continue till all water contained in the grease has evaporated. The same result may be obtained by thoroughly working the grease like butter and removing the drops of water that are squeezed out. The grease must then be brought to a heat just sufficient to keep it fluid. As many flowers as it will hold are then put in, and the whole is kept at this temperature for 24 hours. At the end of this time renew the flowers and repeat the operation for about a week. A grease is finally obtained worth 8 to 10 francs a kilogramme (say 3 or 4 shillings a pound). The calculation of profits is simple. At Cannes and Grasse the flowers of "Cassie" (*Acacia Farnesiana*) for instance, cost 5 to 7 francs the kilogramme. A kilogramme of grease requires 2 kilogrammes of flowers. Labour included, a kilogramme of scented grease is thus worth at least 10 francs in the market. When a sufficient quantity has been prepared it is carefully packed in tins or in bottles and sent to Europe. *Each vessel should bear clearly written and exact information* as to the weight of grease, the quantity of flowers used in it, the time they remained in soak, &c., so that the purchaser may have, besides his own tests, a reliable basis for the price he may give.

In order to extract the essence from this grease or pomade, the latter is just melted and dropped by very small drops into the purest alcohol, in which it remains for ten or twelve days. The essence is then obtained by distillation. The resulting products are, on the one hand, the pure essence, and on the other, a quantity of grease which still contains enough scent to be good for pomade-making.*

It has been already mentioned that certain flowers will not endure treatment with heat. Cold *enfleurage* † may be carried out by means of special frames with glass bottoms. Lard has been mentioned, but mutton fat or any kind of grease will do, provided only that it is clean and perfectly free from smell.

* What becomes of the alcohol is not stated. Nor are the relative proportions of alcohol to the original grease and to the final essence.—(*Transl.*)

† Is cold *maceration* meant? The passage is concise to obscurity.—(*Transl.*)

The process of distillation is well known, but it can only be applied to flowers whose perfume is not destroyed thereby, to leaves, roots, barks, stalks, seeds, resins, &c.

PERFUME-PLANTS.

Orange (Citrus aurantium).—The orange is entitled to precedence. The commonest kind, the sweet orange, was introduced into New Caledonia from Tahiti, and grows luxuriantly. The oranges unfortunately cannot be utilised and rot on the ground. They would yield a wine which, when well made, is equal to Madeira, and fetches 2 to 3 francs a bottle in France.

For perfumery the '*Bigaradier*' orange is the best. Its fruit is not edible, but its flowers have a superier scent. Three kinds of essences are obtained from the orange tree:—

(1) From the flowers. '*Néroli Portugal*' from the sweet orange *is worth 200 francs (£8) a kilogramme* (2¼lbs.). '*Néroli bigarade*' from bitter oranges is worth 500 francs (£20) per kilogramme. One thousand kilogrammes of flowers should yield 300 grammes of essence.

(2) From the pericarp (orange-peel), this essential oil is worth 20 to 25 francs (16 to 20 shillings) the litre. Five kilogrammes of peel yield 312 grammes of essence. It also appears that 100 kilogrammes of oranges * in 100 litres of water yield 1 litre of essence. This result seems to have been obtained from dry peels, but it is better to use them green. The peels are rolled in a vessel whose interior is armed with needle points projecting 2 millimetres (1 line or $\frac{1}{12}$ inch) from its interior surface. The essence pours out and escapes by a hole in the bottom of the vessel.

(3) From the leaves and small green fruits (called *essence de petit grain*).

The flower yields two perfectly distinct scents, according as the extraction has been by *distillation* or by *maceration*. In order to scent a kilogramme of grease, 8 kilogrammes of flowers have to be used in 32 operations, that is to say, 250 grammes of flowers are macerated at a time in the kilogramme of grease. The perfume thus obtained is far superior to that got by distillation. Besides the orange there are various kinds of citron. The essence of citron is worth 16 to 20 francs a kilogramme.

Bergamot—(Citrus Limetta).—This comes mostly from Italy, 100 fruits yield about 85 grammes of essence worth 36 to 50 francs. For some years past a fungoid disease has afflicted the Italian citron trees and considerably raised the price of an essence that is the basis of many perfumes.

* So stated, but dry peel seems to be meant.—(*Transl.*)

Eucalyptus citriodora.—The leaves yield on distillation a delicious essence resembling citron, 1 kilogramme and 700 grammes distilled at Sydney gave 11½ grammes of a pure and colourless essence.

Cassie (Acacia Farnesiana).—This comes next to the oranges, because its pronounced odour of violets * has raised it to a most important place in perfumery. The plant is a native of India, but its introduction into New Caledoina has been a nuisance to farmers on account of the way it is spreading. It is cultivated in Algeria and in France. It is said that a hectare in full production near Cannes brings in a gross revenue of 20,000 francs. This statement may need verification; but it seems to be the case that in the department of Var the Acacia when five years old gives on the average 1 kilogramme of fresh flowers per plant per season, worth 4 to 5 francs a kilogramme, and a hectare can carry 5,000 plants When dried in the shade, the flowers retain their perfume, 10 kilogrammes of fresh flowers yield 74 grammes of essence. Two kilogrammes of flowers will scent 1 kilogramme of grease. One person can gather 700 grammes of flowers in an hour. This plant also yields a gum as good as gum arabic. A plant two years old has yielded 60 grammes of gum, and a plant four years old 180 grammes. The bark and the pod are both rich in tannin. The flower will not bear distillation, *enfleurage* or maceration must be employed.

The "black wattle" (*Acacia decurrens*) of Australia has a flower possessing the same odour, and the gum was quoted on the London market in 1895 at 1,500 francs for the ton. The flowers of *Acacia Lebbeck* (? Albizzia Lebbeck.—*Transl.*) and those of the false guaiacum (*Acacia spirorbis*) are as yet unknown in perfumery, and would seemingly be fit companions with the "Cassie." †

Geranium capitatum grows exceedingly well in New Caledonia. The essence is worth 35 to 40 francs a kilogramme. That made in Algiers is worth more than the Indian variety. A kilogramme of leaves gives a gramme of essence. With two cuttings a hectare will produce about 40,000 kilogrammes of leaves, and these will yield 36 to 39 kilogrammes of an essence which resembles and frequently adulterates the essence of roses.

Heliotropium Peruvianum. When carefully grown, this plant may become a considerable shrub and will go on flowering for half the year. It is one of the safest and most paying of plants. The essence may be obtained either by enfleurage or by maceration. In France a great deal of artificial heliotrope is used, but the natural extract will always fetch its value. Good

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* This resemblance has never occurred to me, though the smell is delicious. —(*Transl.*)

† The flower of Albizzia Lebbeck and odoratissima loses its delicious perfume and acquires a stale one almost immediately it is gathered. It would have to go straight from the tree to the grease.—(*Transl.*)

heliotrope pomade (genuine) is currently sold in London at 20 francs the half kilo. (about £14 or £15 a lb.) This perfume may be also obtained by the agency of carbon sulphide. M. Piver obtained 6 kilogrammes of it from the plants growing on 1 hectare at a cost of 3,000 francs, or 500 francs the kilogramme. Four grammes were sufficient to scent a kilogramme of pomade.

Jasminum grandiflorum. Grease or pomade scented with this fetches 7 to 15 francs according to quality. The flowers are worth 4 to 6 francs the kilo. at Cannes. A hectare of jasmin will yield about 2 kilos. of an essence which, when pure, is sold in France and Egypt at 500 to 550 francs an ounce (31 grammes) or 16 to 17,000 francs the kilo. A woman can gather 1 to 2 kilos. of flowers daily. In Algiers 100 plants give 150 kilos. of flowers annually. A hectare may carry 5,000 plants, the daily produce of which may be 50 to 60 kilos. of flowers, or 7,000 to 9,000 kilos. annually. One hundred kilos. of flowers yield 12 to 14 grammes of essential oil. One hundred plants yield 25 to 28 grammes. The oil obtained by distillation has always a strong and somewhat empyreumatic odour, and will bear no comparison with that which has been obtained by *enfleurage* or by ether extraction, much less with that of the natural flowers. The gathering should be done up to 9 A.M., and from 5 to 7 P.M. When it rains the wetted flowers have to be thrown away, because they lose their perfume and turn brown. The rainfall is thus a consideration.

Vetyver or *Khuskhus* (Andropogon muricatus).—The roots are worth 2 to 3, and very exceptionally 6 francs the kilo. According to Jeanneney's rough tests, the roots contain 1·3 per cent. of essential oil. A clump two years old may have 800 grammes of dried roots. The essence is brownish, soluble in alcohol, and worth 25 to 30 francs the kilo.

Citronella (Andropogon Schœnanthus).—The essence is worth 40 to 50 francs the kilo. It is much used in England (lemon-grass oil.—*Transl.*) and is obtained by distilling the leaves, which yield 500 grammes of essence per 100 kilos. of leaves.

There are many other plants not recognised in the trade as yet, but perfectly likely to give profitable results; for instance, the following:—

Lantana camara and *aculeata*, the unarmed and the thorny species. The latter especially is more free-growing than welcome, and as it cannot be exterminated might as well be utilised. The leaves and twigs are aromatic and might be distilled, as they furnish 250 grammes of essence per 1,000 kilos. This product might be used either in perfumery or in medicine. The leaves are used for colds and fevers.

Carica papaya, the male flowers of the *papaya*.

Beilschmiedia lanceolata, or musk sandal.—The bark and seeds yield an essential oil smelling somewhat like Russia

leather, 250 grammes of essence from 100 kilos of bark or seeds worth about 12 francs the kilo.

Santalum album and *austro-caledonicum*, well known.

Thespesia populnea, or Oceania rosewood.—The timber is valuable for cabinet work, and yields a fine brownish essence which would be excellent in perfumery. Worth about 30 francs the litre.

The Hill Tribes of Cochin.

THE hill tribes of Cochin are divided into the two principal classes of Malayars and Kadars. The former are found in the forests of Machad, Elnad, Paravattany and Palappilly, while the latter are confined to those of Kodassery and Nelliampathies.

The Malayars, again, are divided into the two sub-divisions of Konga (immigrants from the Tamil country), Malayars and Nattu (belonging to the country) Malayars. The former, as their name signifies, are said to have come from the neighbouring Tamil districts of Coimbatore and settled in the Cochin hills, while the latter claim to be the original settlers of the Cochin forests.

(1) The Nattu Malayars are not themselves divided into any different sections. They observe a sort of pollution towards their Konga brethren who are not allowed to approach them beyond a certain fixed distance. From the above it may be inferred that no sort of connection can possibly exist between the Konga and Nattu Malayars. The Nattu Malayars are copper-coloured, short in stature. and have invariably a triangular face pointing towards the chin. They have great powers of endurance as other jungle tribes, and live mostly on jungle minor products, the extraction of which forms their chief occupation. They speak a peculiar dialect formed, as it were, by an admixture of Malayalam and Tamil. They live in small huts built of bamboo, teak or reed-leaves, date-leaves, grass, &c. A Malayar village consists of not more than 10 or 15 huts of the above description. They are more clean than the Konga Malayars, who, I am informed, hardly take a bath in a week even in the hottest part of the year. They have curly hair and pouting lips, which are not thick. They are gentle and submissive, and may invariably be trusted to a great extent.

They live, as was said before, in villages of 10 or 15 huts, each of which contains a family. Under ordinary circumstances marriages take place between the members of different villages, but very rarely between those of the same village. It is a general rule that discipline can be more strictly maintained over a stranger than over one's kith and kin, and consequently the Mooppen or headman of the village can command greater control over the village individuals if inter-marriages are not allowed between members of the same village. Early marriage for

females is an exception; much more, therefore, is it for males. After marriage the couple live by themselves and can lay no claim whatever to any remuneration from their parents. Dowries, which consist of poonies (honeycomb-collecting baskets), &c., of daily use, are usually given. The married pair must live or starve by their own exertions. Children are not usually taught to read or write. Christian missionaries have recently directed their attention to educating the Malayars and proselytizing them. Both males and females take liberally to the pernicious habit of using intoxicating liquors even from their ninth year. Opium is resorted to but by few.

Pollution by the death of relatives is unknown among the Malayars. Similar to what is prevalent among the Nairs, they have a sort of dance in which both males and females take part indiscriminately. Intoxication, it need not be added, adds fuel to the dance.

I have heard it said that Malayars and Kadars do not give any name to their children till after a certain age. But so far as my enquiry goes, this is a mistaken idea. I have seen, both among Kadars and Malayars, children of 8 months' old being called Kalí and Choundan.

Malayars have not advanced a bit in civilization. They have an inherent hatred for anything new, and cling obstinately to their old customs and ways of living.

(2) The Konga Malayars, who are not allowed to approach their Nattu brethren, are said to have immigrated into Cochin forests from the eastern British territories. They are darker in colour than the Nattu Malayars, and have social and religious customs similar to those of the others, but with one great difference. Their matrimonial arrangements are very peculiar. After the selection of the bride by the parents of the bridegroom, the latter comes for the first time to the house of the bride, whose parents then receive, in the presence of not less than four witnesses, a sum of not less than Rs.3 from the bridegroom as the price of their daughter. After the usual feastings and merry-makings the bride is taken to the house of the bridegroom. Subsequently, if at any time a divorce is resorted to on any account whatever, the bridegroom brings his wife to her parents and delivers her to them after recovering, in the presence of the same four witnesses, if possible, the price he gave at the time of his marriage. Marriage is, therefore, considered as a mercantile business, where the commodity, if found unfit for the purchaser, is returned to the owner and the value of the same taken back. Instances of the above are very rare, though it is sanctioned by the society.

(3) The Kadars who are confined to the Nelliampathies and Kodasseries (Adirappilly) are darker-coloured than the

above tribes, have pouting thick lips and curly hair, and are shorter and more muscular. The first sight of a Kadar reminded me of a Bushman whom I had the good luck to see at Madras in 1894. The Kadars do not mingle with the Malayars and the Nelliampathy Kadars consider themselves to belong to a class higher than that of their Kodasseri kinsmen.

Their social and religious observances and their ways of living are similar to those of the Nattu Malayars. They are more cunning and deceitful, and do not hesitate to utter bare falsehoods. Owing to their constant contact with coffee-planters they have become more civilized in appearance, though none of them know how to read or write.

The religion of the jungle tribes is a sort of Hinduism mixed with Fetichism. They worship Durga, evil-spirits, elephants, &c. Trees which they believe to be frequented by evil-spirits are not allowed to be cut, but are, on the other hand, worshipped. Wild elephants are worshipped, as also are their images. Tamed elephants are beleived to have lost the divine element in them by their association with human beings. Short-tailed black monkeys (Hanuman) are considered to be a sort of curse to the forests, and consequently they are hunted after and put to death whenever and wherever they are met with. Serpent-worship is unknown among the jungle tribes.

The jungle tribes are everywhere presumed to be under the Forest Department of the State within whose jurisdiction they live. They are granted certain concessions which are denied to the inhabitants of the low-country. Though this has been strictly true in Cochin in days of yore, a change has recently taken place. The constant contact of the jungle tribes with merchants who, coupled with the high wages that the jungle tribes receive from the European coffee planters who employ them largely in their malarious coffee estates, has tended a great deal to estrange the Malayars and Kadars from their old relationship with the Government. It would not therefore be out of place to state here that certain sets of rules which would enhance the right of Government to count upon the work to be extracted from the jungle tribes are highly necessary, since without them every kind of work in the forests is out of the question. It must, at the same time, be kept in mind that the presents distributed and the concessions granted to the jungle tribes should be strictly observed, and that any interference with their social and religious observances by low-country people should be duly enquired into and grievances redressed; and that the protection which they have a right to claim should be extended to them properly. To sum up, Government and jungle tribes should each be careful to perform their duty towards each other.

K. G. MENON,
Cochin Forest Service.

Trichur, 26th April, 1901.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

The Maihongson Forests in Siam.

THE Siam Forest Department has been so often and, I fear, so justly reproached for not contributing to the *Forester* that I venture to send you extracts from an interesting report of Mr. J. G. F. Marshall on the celebrated (in Siam) Me Lan forest from notes taken by him on a trip in March, 1901. This Me Lan formed part of the Maihongson (the "Me Haung-thun" of the Kado returns) forest, the lease of which has just expired. It has now been released separately. But little work has ever been done in this forest owing to the extreme difficulties of extraction, but Messrs. The Bombay, Burma Trading Corporation, Limited, are now making an effort to overcome these with every hope of success. The whole area is a vast amphitheatre or "Kut" as Mr. Marshall calls it, and all the streams disappear under a high limestone ridge. The only possible means of extraction is to float the logs down to near the point of this disappearance and then drag them over the ridge. The logs eventually find their way into the Maihongson stream, and after floating for several miles through Karenni territory reach the Salween in Lat. 19°.

CHIENGMAI:
19*th May*, 1901.

H. SLADE.

SITUATION.

The Me Lan forest is situated in the sub-districts of Maihongson and Muang Heng in the Chiengmai State of N.-W. Siam. It is bounded on the north by British territory.

BOUNDARIES:—

On the south by the Me Tan and H. Sam-poo watershed and the Kut Sam-sip range of hills; west by the watershed of the Me Pai and Kong Noi; and east by the Me Kong watershed.

PAST HISTORY.

Until within the last 15 years the only villages within the forest were Me Lanah and Ban Me Pem, both of which have

grown considerably, the former from 5 or 6 to 25 houses and the latter from 2 or 3 to 15.

In addition there are now the following villages, *vide* map, Ban Me Pah, Ban Poong Net, Ban Loi Mon, Ban Mg. Chang, B. Kai Pa, B. Pa Mon, B. Sup Me Heng and a Chinese settlement of about 60 houses up the Me Lan above H. Maklet.

The influx is attributed chiefly to the annexation of Upper Burma, and consequent clearing out of dacoits from the Southern Shan States, except in the case of the Chinese settlers, who have only come here within the last three years.

The consequence of this comparatively populous condition is that game of all sorts which used to abound from elephants downwards has been driven to the head waters of streams and to the high range of hills which divides British from Siamese territory. Another consequence is extensive cutting of taungyas (temporary cultivation), chiefly, however, in evergreen forest; objects of cultivation being rice, pulses, pumpkins, yams and chilies. The Chinese also grow poppy extensively for personal consumption and sale in the Shan villages. A general dread of the forest appears to have existed for a long time owing, presumably, to its weird caves, tunnels and subterranean passages; indeed, even now it is very hard to get Shans to enter a cave or tunnel alone, or even with their own friends, although they will, more or less readily, accompany Europeans.

Old Workings.

Teak has been worked out for years on the upper slopes round and about Nam Howo and also below the Me Oo Moung, but never of large size; logs of not more than 7' girth being the class chiefly extracted. Girdlings of all sizes were, however, extensively carried out throughout the area, and in January, 1898, 10,000 trees were girdled by Messrs. The Bombay, Burma Trading Corporation, Limited.

These were chiefly of large size, the consequence being that the seed-bearing qualities of very numerous trees were lost entirely for a succession of years, and in the practically absolute dearth of seed-bearers there is little or no recent reproduction and very few saplings. This point will be further discussed under the heading of "Natural Reproduction."

Aspect.

This is very hard to determine owing to its general character, but may be said to be chiefly S.-W. and S.-E.

Geology.

Most of the main ridges in the lower portion, *i.e.*, the south and south-west, are topped with huge rocks of volcanic origin (trap). In places again there are cliffs of what looks very like limestone (I had no means of testing to make sure), and

undoubtedly the stalactites formed, and in process of formation, in all the caves are largely composed of this mineral. The whole area strikes me as being the result of tremendous volcanic upheaval. I fear I am no geologist, however, and my conclusions may be wrong. The soil generally is a reddish gravel, feldspathic and granitic in origin.

PHYSICAL FEATURES.

Pages could be written of the extraordinary features of this forest, a unique one among the timber-producing tracts of the east, if not the world. The most pronounced are what may be called, in default of a better word, the almost innumerable amphitheatres, ranging from hollows a few yards across, to the large ones of the Me Lan and Me Lanah which are roughly 2 miles and 3¾ miles broad and 23 and 8 miles long respectively.

The water collected by the catchment areas of these disappears underground, generally under a huge precipitous hill face or rocky bluff, to re-appear again in different places on the other side of the ridge. The most notable of these re-appearances is the cave from which the H. Kann flows (this is the reputed outlet of the Me Lanah), the Op Papoo and the cave from which the Me Kong Me Lan flows, both said to be outlets of the Me Lan.

The areas covered by these amphitheatres are at Kut* Samsip at the head waters of the Me Tann and H. Sam Poo, and the area lying between the head waters of the H. Heng up to and round Nam Ho-wo.

Another extraordinary feature is the innumerable caves and underground passages, notably the one near the mouth of the H. Heng on where the Me Lan runs under a hill in a tunnel 300 yards long and 30' to 80' wide and 20' to 70' high, then the tunnel from which the H. Kann emerges. This has never been thoroughly inspected by a human being, although two assistants of Messrs. The Bombay, Burma Trading Corporation, Limited, went in over a mile until their torches gave out. This is locally supposed to be the outlet of the Me Lanah; then there are the caves at the disappearance of the Me Lan, a large cave at Nong Keo and innumerable others all over the country of more or less extent. It seems most probable that the whole of this area is undermined by innumerable tunnels and possibly by a huge subterranean lake.

The main outlets of water are at the Op† Papoo, the Me Kann and the Me Lan, which runs into the Me Kong. The Me Kann is a feeder of the Poong Sam Pik, which again runs into the Me Kong.

* "Kut" is the Shan equivalent for these amphitheatres; "Kut Sam-sip" then means "Thirty amphitheatres."

† "Op" or "Awp" = Gorge.

Another peculiarity which I cannot vouch for from personal experience is the fact, attested to, however, by several of the Messrs. The Bombay, Burma Trading Company, Limited, assistants, that a rise in the disappearing stream in the hills does not necessarily mean a rise in their reputed outlets. For this, if a fact, I can offer no explanation.

General Character of Forest.

1. *Teak.*—To deal with the teak-bearing area first, which the broken line on the sketch map encompasses. It will be noted that this area is not by any means large, and from it have to be deducted all ridges and their immediately adjacent slopes which, as a rule, are rocky and barren, or are clothed with Pine (*P. Khasya*) and Eng (*Dipterocarpus tuberculatus*), all evergreen patches, which as a rule are, however, not extensive, and generally found along banks of streams, and last pure Eng forest of which there is a considerable area.

In the semi-evergreen forest teak of large size is fairly plentiful, but there is no reproduction and few or no unsuppressed saplings. The annexed statement shows two linear valuation surveys made. These are necessarily very rough, but were through fairly well stocked forest. The dotted line on sketch map shows their general direction.

Taken generally, the situation may be summed up thus. Nearly all teak over 6′ 6″ have been girdled, and a large number below that size. I estimate roughly that there are not more than 10,000 trees fit to girdle left, and of these at least half the number cannot be girdled under the isolated-tree clause of the lease. Saplings of 15 years old and upward are fairly frequent, but not sufficient to secure the future of the forest as a teak-bearing area of any importance. Reproduction is very poor indeed everywhere.

Natural Reproduction.

Reasons for absence of reproduction are chiefly :—

(i) Girdling of nearly all seed-bearers, some as long ago as 15 years and the most recent $3\frac{1}{4}$ years, and thus the total loss of seed crops during that period. It is estimated by Messrs. The Bombay, Burma Trading Corporation, Limited, that there are 10,000 old girdlings in the forests and 10,000 of their own girdlings.

(ii) Suppression by semi-evergreen forest and bamboos.

There is just a chance of a good crop of seedlings asserting themselves, in places where bamboos are now seeding, in say, three years' time after the same have fallen and been burnt; but I fear the chance is a very slight one owing to the rapidity with which the bamboo re-asserts itself to the ultimate exclusion of light-exacting species which have only a short start of them.

(iii) Rank growth of grass and consequent difficulty of seed to reach the ground if no fires occur, and certainty of destruction of the same if they do occur, before seed has established itself.

ARTIFICIAL REPRODUCTION.

It is not necessary to discuss this point, as the physical difficulties of extraction alone would imperatively forbid such being attempted, even if there were not large areas elsewhere, notably between Chiengmai and Paknampo and on the Thaungyin in which such operations should first be carried out.

(iv) *Trees other than Teak.*—There is one large tract of deciduous forest, the Me Lanah valley, which for no reason one can see, has not a teak tree on it, although its usual congeners are frequent. The principal species being Padouk (*Pterocarpus indicus*), Pyingado (*Xylia dolabriformis*), Thitya (*Shorea obtusa*), Thitsi (*Melanorrhœa usitata*), Sheenpya and Shaw nee (*Sterculias*) Eng (*Dipterocarpus tuberculatus*), Tong (*Anogeissus* sp.), Taukkyan (*Terminalia tomentosa*), *Bassia latifolia*, *Cordia Ehretioides*, *Morinda* sp., *Mallotus Phillipinensis*, *Melia* sp. with Thingan (*Hopea odorata*), Thitkado (*Cedrela toona*), Pyinma (*Lagerstrœmia* sp.), *Albizzia* and *Fici* of many species in the semi-evergreen and evergreen portions and several other trees I failed to identify.

Natural reproduction is bad throughout, chiefly owing to annually recurring forest fires, the growth of grass being rank owing to a very open leaf canopy.

The pine and Eng areas are practically of no value, resin is only extracted in very small quantities for local use from the former, and reproduction of both, owing chiefly to forest fires, is poor. The evergreen areas are practically the whole forest north of the broken line which defines the teak area on the north, in the hollows of all "kuts," and along banks of streams in many places.

These areas are intersected with frequent patches of bamboo (tinwa *Cephalostachyum pergracile*, and wagoke, *Oxytenanthera albo-ciliata*). The latter is seeding throughout the forest; Wabo, Myinwa, (*Dendrocalamus strictus*) and Wanet are also found; the first named in deep moist evergreen forest where it grows to great size. These evergreen and bamboo areas are chiefly selected for ya cutting; I have not come across a single instance, I am glad to say, of a teak-bearing patch being cut. The regrowth in such taungyas is usually a high rank grass, which gradually gives place to tree growth or bamboos. Except by the Chinese, yas are cultivated for two years. The Chinese cut fresh areas each year.

ANIMALS.

(i) *Man.*—There are five races inhabiting the forest, *viz*:—Shans, Chinese, Karens, Thaungthus and Musus (Mokesos). The most numerous are:—

The Shans who inhabit B. Me Pah, B. Me Lanah, B. Ung Chang, B. Kum Hoi and Muang Pem, B. Pamon, B. Sup

Me Heng. These people live ostensibly by paddy cultivation and taungya in B. Me Pah, Muang Pem and Me Lanah, and taungya alone in the other villages, eked out by a little dacoity and elephant-stealing at times and a good deal of shooting and fishing. A few also are now working for Messrs. The Bombay Burma Trading Corporation, Limited, on their road work and as elephant men and also for their foresters at timber felling, logging, &c.

The Karens' head-quarter village is Loi Mon, 2½ miles from the mouth of the Me Heng Luang up the ridge, between that stream and the Me Lang Heng. Their taungyas are in all the valleys round about.

These people are supposed to be the Karen pyu of Burma, but are nearly all at least half Shan. They dress exactly as do Shans, both men and women. They have a phongyi kyoung (Buddhist monastery) with a phongyi (monk) and four koyins (novices); there are no pigs in the village at all, and they are not at all timid; in fact I found them the pleasantest people I met in the whole valley, and the most hospitable. They speak Karen with a number of Shan words thrown in, and all know Shan thoroughly.

The Chinese settlement (I cannot term it a village as these people live in small congeries of huts of from two to twenty together) is dotted all over the head waters of the H. Wye, H. Pa Tope and H. Maklot, feeders of the Me Lan. These belong to the Ke Mraow tribe of Chinese hill-dwellers, the other is called Ke Tow by the Shans. Accounts as to their numbers living in these forests vary from 200 to 500. From what I saw of the three or four groups of houses I visited and the huge area taungya'd, I am inclined, to think the larger number the more correct.

Very few of them know Shan, but they can all talk Lao to some extent, and come from the country north of French Laos. The men do not wear pig-tails, but a small tuft of hair at the back of their heads, some of which is allowed to grow 6″ to 8″ long, but no longer apparently. They wear baggy trousers like Shans, with short coats of dark-blue home-woven stuff. The women wear regular quilts very little lower than the Karen, which are often quilted slightly and much pleated, with, at times, a more or less white jacket, generally open. These appear to me distinctly finer specimens of humanity than the men, and apparently breed prolifically, judging by the swarms of children one sees.

They raise large crops of paddy and opium, and also possess numerous pigs, fowls, goats and cattle. In a word, they appear by a long way the best to do in this tract. Like Chinese, as a rule, they are most industrious; it is only three years, for instance, since they arrived in these forests, and they have felled and cultivated, I estimate, at least 2,000 acres of fine forest land (evergreen). They pay no taxes, and if they go on as they are

now doing, in ten years' time there will not be an acre untaungya'd in the headwaters of the Me Lan.

They freely give their reason for trekking from their own country that there were no more forests to taungya, and it was too populous. I expect also that they had to pay taxes, or were otherwise wrung by Chinese officials.

Fowls, pigs, rice, vegetables, &., are fairly cheap; but, I fear, will not remain so long now that the B. B. C. have such a large establishment in the Me Lan.

Taungthus are not numerous, and those there are have become so strong Shan that it is hard for a Shan to distinguish them, and impossible for a European to do so. They live and intermarry with Shans and follow the same pursuits.

Musus ("Mokeso" Burmese).—These quaint primitive and extraordinary people are not found elsewhere in Siam, so I understand, nor have I ever met them or even heard of them in Burma. There are considerable numbers in south-west China and in the Southern Shan States; they live much as do Karens, but their villages are even more remote from towns and villages, and generally range from five to twenty houses on a ridge right at the head waters of streams with their taungyas below them; they are extremely dirty and seem to me to all suffer from itch, which they appear to take no steps to rid themselves of. They are Nat-worshippers, and have no idea, as far as I could judge, of a Supreme Being. When they are dressed in their best, generally at a wedding or upon coming into a town, they are really singularly picturesque figures, with large silver earrings and buttons, and sort of medallion brooches, the women that is; the men dress much as do Shans, but are wilder looking, more untidy and infinitely dirtier.

From what I have said above, one would think they were shy; but they are very far from being so, especially in their villages, where women and children swarm down to your camp and would relieve you of all you possessed if you gave way to their importunities. In towns they think nothing of walking up the steps of one's house and satisfying, or trying to satisfy, their insatiable curiosity. They live on the produce of their taungyas eked out with what they shoot, chiefly with a species of cross-bow and a deadly poisonous arrow, a cut even from which is said to be certain death.

Much could be written about these singular wild but fearless people, which cannot be contained in the short paragraphs of a forest report. They deserve special study.

ii.—Other Animals. My guide, who was last in this valley 12 to 14 years ago (and who is a typical old dacoit-looking Shan, a very powerful man, tattooed from head to foot, tells me that at that time elephants, bison, and sine (*Bos sondaicus*) were plentiful right down to the Me Pah village, and sambhar, to quote his own words, could be shot two or three in a day.

Now bison and sine are confined to the huge range dividing British from Siamese territory, seldom coming lower than the upper ridges forming the catchment area of the H. Heng Luang and Me Lan Heng.

Elephants are pratically non-existent, but rhino are said to be *occasionally found in the high range alluded to above.* Sambhar still are fairly plentiful, but are fast being exterminated.

I do not suppose a single moonlight night passes but one or more Shan hunters sit up at each of the saltlicks marked in the map and at others, and very often with fatal result. Bands of these hunters are repeatedly met. Gyi (barking deer) are fairly plentiful and the serow (I think from its tracks), and another mountain goat allied very closely to the gooral. Jungle fowl and imperial pigeon are very numerous in parts.

Tigers and panthers are conspicuously absent. I came across no pugs even, during the whole of my time in the forest.

Fish swarm in all the creeks, which is extraordinary considering the way they are fished by all and by all methods from dynamite to the hook. Every man appears to have a gun, generally a flint-lock, although a few possess Winchesters, which all appear to have been smuggled over from British territory, from Upper Burma, so the people were unanimous in telling me. The Chinese have the most extraordinary looking jingals with pistol handle and very long barrels. The price of a really fair flint-lock is wonderfully *cheap, ranging from Rs.12 to Rs.20 at the very* most, which shows that importation must be very frequent and plentiful.

Line of Export.

In old days the line of export was very much the line Messrs. The B. B. T. C. L. are now taking, but to avoid the slip which, though very short, is particularly steep and rocky, and ends in a dry rocky stream; they are cutting a road as shown in the map, or rather drag-path which will have its terminus in the Pong Sam Prik, an almost floatable stream, thus avoiding not only the slip aforesaid but a two-mile *aung* (pushing by elephants) and drag down the H. Kann and another mile and a half down the Pong Sam Prik.

Between the head of the slip and the head of the block-and-tackle path, the distance is $3\frac{3}{8}$ miles, the ruling gradient being 1 in 20, and the maximum 1 in 12 or approximately so. The part on which it is intended to use the block-and-tackle arrangement is only 810 yards, but is very steep in parts; if a cart-road could be in any way got up this part timber could be carted from B. Me Pah to the Pong Sam Prik at a greatly diminished cost. Apparently this is not feasible, at least, so it has been decided by Messrs. The B. B. T. C. L. and their advisers.

The work of dragging logs from B. Me Pah at the foot of the hills on the Me Lan side to the Pong Sam Prik, is at present

intended to be negotiated by the Corporation as they have not yet, so I understand, been able to get any one to take up the work on contract, although they may, and very probably will, do so later on when once the tackle is up and in full working order.

* * * * * *

VALUATION SURVEYS.

Me Lan.

Girdled Teak.				Green Teak.				
Over 8′ girth.	Over 6′, under 8′.	Under 6′, over $3\frac{1}{2}$′	Under $3\frac{1}{2}$′.	Over 8′.	Under 8′, over 6′.	Over 6 under $3\frac{1}{2}$′.	Under $3\frac{1}{2}$′ over 6″.	Advance growth.
No. I.								
18	13	4	...	3	12	14	18	42
Per acre, 0·50	0·36	0·11	...	0·08	0·33	0·39	0·50	1·17
Total 124								
Length of line 1 mile × 100 yards = 36 acres.								
No. II.								
6	8	3	...	4	7	11	16	31
0·07	0·09	0·03	...	0·05	0·09	0·14	0·20	0·38
Total 86								
Line, $2\frac{1}{4}$ miles × 100 yards area = $81\frac{1}{2}$ areas.								

J. G. F. MARSHALL,
Forest Officer, on Special Duty.

VI.—EXTRACTS, NOTES AND QUERIES.

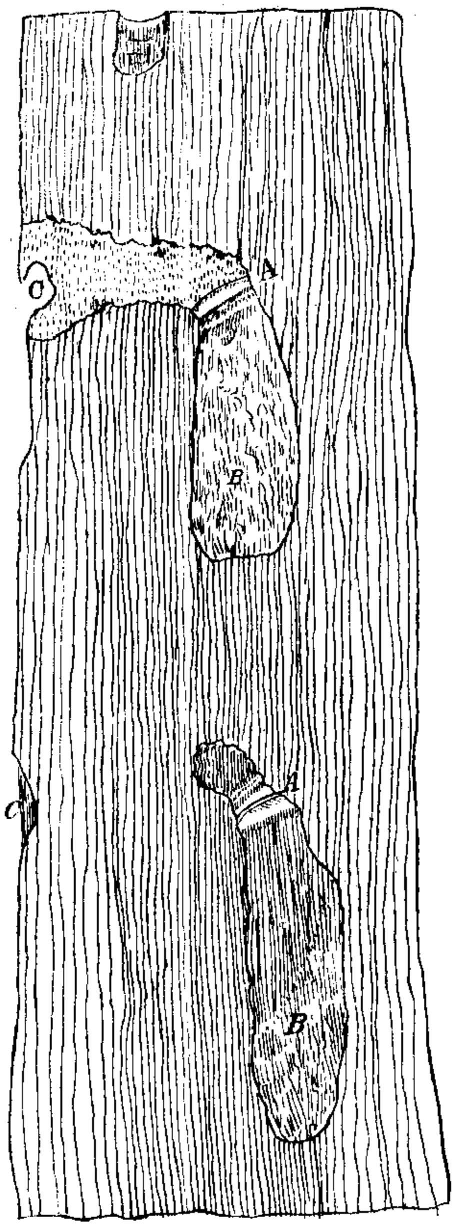
Notes on a Beetle injurious to Chloroxylon Swietenia in Ceylon.

Æolesthes induta.—Lewin. The Satinwood-borer.

(a)—*Description.*

THE beetle referred to belongs to the Longicorn family. The body is $1\frac{1}{4}''$ to $1\frac{1}{2}''$ in length, and the antennæ from $1\frac{3}{4}''$ to $2''$ more. It is dull-brown in appearance, with apparently no markings, and is covered with fine silky brown hair, but when turned about so as to get the sun to play on it, it gives one just the appearance of polished satinwood itself.

SKETCH showing chambers excavated by Longicorn Beetle in *Chloroxylon Swietenia*.



C = Mouth of chamber.

B = Pupal chamber.

A = Door shutting up chamber, composed of some calcareous substance.

The Imago emerges March.

Pupal chamber is excavated September and November.

Larva from April, May and October.

Egg laid in bark of dead and unsound trees.

(b)—*Life History.*

Flight.—At end of February and March.

The eggs are laid in the bark of newly-felled, dying or injured trees; so far as is yet known they do not attack healthy trees. A large number of eggs must be laid in each tree, as I have found as many as 30 larvæ in one small sapling, and never less than a dozen or so in one tree. The young larvæ when hatched commence boring a tunnel in between the bark and the sapwood. The tunnels are exceedingly tortuous, and completely ring the tree. The sapwood of the tree has precisely similar markings on it. The larva, when full grown, bores a hole into the sapwood, but sometimes penetrates as far as the heart-wood (my specimens went in about September, but I have known cases of them going into the wood earlier). Here he pupates shutting off his house from the outside world by a neat door made of some calcareous substance. I annex a sketch showing the chamber made, which is always of much the same shape and size. Here he remains until the end of the following February or March, when he undergoes his last change and emerges as a beetle. I am so far of opinion that there is only one brood a year, but this requires further investigation.

(c)—*Relations to the Forest.*

Any one walking through our low-country forests in Ceylon, throughout which satinwood is to be found, cannot help noticing scattered through the forest, either dead branches of living trees or young dead trees of satinwood, completely barked and studded with fairly large holes. This is the work of the *Æolesthes.* The effect of these tunnels is to cause the bark to drop off in large pieces.

Natives frequently wound the bark of the satin to obtain the gum, which flows fairly freely, and here the beetle generally finds an opening to attack.

'*Viscum orientale,*' a mistletoe, also grows on satin branches, frequently strangling and killing off the branch it is on; this is another chance for the borer, while trees growing on ridges are particularly liable to attack, as they so often have branches broken off by the wind. So far as I know, satinwood (*Swietenia chloroxylon*) is the only tree attacked by this beetle.

(d)—*Protective Rules.*

All satin logs felled for sale should be immediately barked, as then the beetle has no place to lay its eggs. Satin branches, not marketable, should be left as traps, for two or three months, and then all burnt off, as 20 to 30 larvæ will probably be found in each branch of any size, and hundreds could be killed off each year.

Frequent thinnings and quick removal of all sickly trees.

H. P. C. Armitage,
Asst. Conservator, Forests, Ceylon.

THE

INDIAN FORESTER.

Vol. XXVII.] October, 1901. [No. 10

Thinnings.

By H.

A famous authority explains in a small-type foot-note on page 107 of the July number of the *Revue des Eaux et Forêts,* the class, *i.e.* degrees of thinnings (*Durchforstung*) known in Germany by the letters A, B, and C, and the difference between the new style described by D and what is understood by thinning (*éclaircie*) in France. As these explanations should be known by heart and be looming large in the mind of every officer who has thinnings to make, whether in pure sâl poles or in mixed crops of deodar and *P. excelsa,* or of sandal and casuarina, we take the liberty of translating the little foot-note for the benefit of our readers.

"(*a*) The thinning A consists in the removal of dead wood only. The thinning B comprises at the same time the cutting out of all completely suppressed stems. The thinning C goes farther and includes for removal the *distinctly slow-growing individuals,* whose extreme tops only are mixed up in the canopy.

"(*b*) The thinning D differs essentially from the French *éclaircie*—

"*First,* because it includes a weeding, *i.e.*, the cutting out of a *dominant canopy;*

"*Second,* in that it provides for the removal from the main crop of only such stems as have incomplete or contracted crowns. It is also a harvesting cutting, whereas the *éclaircie* is a true improvement felling. This latter very often carries with it, particularly in mixed crops, the cutting out of the biggest and tallest trees when they are detrimental to individuals of a more precious kind or of better shape."

Is it not from the *éclaircie,* well understood and carried out with one's eyes on the canopy, that we may learn to thin successfully, rather than from the more narrowly defined *Durchforsten* A, B, C, or D?

A Teak-boring Mollusk.

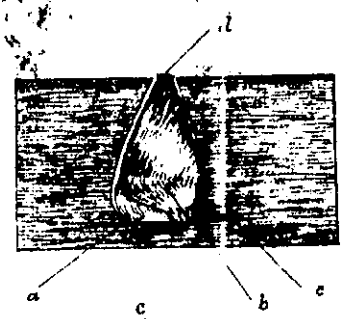
By R. S. Troup, *F. C. H.*

Martesia fluminalis is the name given to a mollusk which is prevalent in the brackish waters of the Pegu Canal, Lower Burma, and which causes a certain amount of damage to teak logs stored there for any length of time in the water. This particular mollusk is an estuarine species of the Pholad family, all of which are boring mollusks and will destroy anything but iron. Although normally found in estuarine waters, they have a tendency to spread above tidal influence into fresh water.

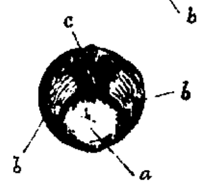
From the diagrams it will be seen that the creature is conical in shape, the boring end being the broad end. The largest specimens I have found measure three-quarters of an inch in length and half an inch in diameter at the base. It is whitish in colour, soft inside, with a rather thin shelly covering. An exterior examination of a teak log attacked by *Martesia fluminalis* reveals numerous small holes about one-sixth of an inch in diameter. On cutting the wood open the mollusk may be found in a cavity which it fits, the narrow end (orifice) pointing outwards towards the external hole in the log; it is evident, therefore, that the animal gets in when small and grows inside. As far as I have been able to ascertain, this mollusk does not burrow deep into the timber; the destruction, however, of the external layers of teak logs is a sufficient argument against the storage of teak timber in brackish waters where these animals abound.

A Teak-boring Mollusk

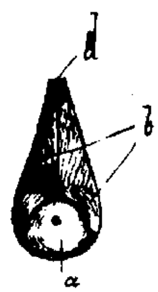
Martesia fluminalis
(actual size)



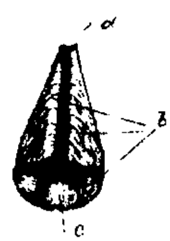
the mollusk embedded (side view)



2. View of mollusk from beneath



3. Front view



4. Back view

a = Soft interior. b = shelly covering.
c = membranous plate. d = orifice.

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, August 1901.
Regd. No. D. 460, I. F.- Aug. 1901 - 35

VI.- EXTRACTS, NOTES AND QUERIES.

Teak Industry of Siam.

One of the principal industries of Siam is the teak timber business, says Consul-General Hamilton King of Bangkok. Teak is the most valuable timber for shipbuilding in the world. It does not yield to the influences of moisture and drought; it is not liable to the attack of borers and other insects; it does not split or sprawl; and, while it is a strong, durable wood, it is easy to work and very light in the water. As a beautiful, dark-coloured wood susceptible of a very high degree of finish, it will continue to be in demand wherever fine finishing timber is needed in shipbuilding, and because of its peculiar qualities that resist the influences of iron when brought in close contact therewith, there is no substitute for it yet discovered as the backing for armour plates in vessels of war.

Because of the attention given at this time to our navy and merchant marine, information on this subject should be of interest in the United States.

The area of the earth's surface in which valuable teak forests are found is not extensive, being restricted to Burma, Siam, and Cochin China. Some teak has been found in Java, but it is not of a superior quality, and as yet the forests of Cochin China and a part of Siam are inaccessible. The limit of their area and the increasing demands now made upon these forests, because of the rapid growth of shipping throughout the world, is presenting a a problem which the British Government has attempted to solve by planting new forests; but many of these attempts have proved failures, and at best it takes from sixty to eighty years to grow a tree large enough for superior timber.

There are but three ports in the world from which teak is exported; Rangoon, Moulmein and Bangkok. Of these, Rangoon stands first and Bangkok and Moulmein rank about equal in the amount exported by each.

The term "teak forest" is a misnomer; for the teak trees do not form a forest as the term is understood in America, but generally are rather found in clumps, or perchance as individual trees in forests and jungle among other timber. This wood grows upon the mountain sides and in high, broken country, and is segregated to the extent of one tree for every ten or one hundred trees of other kinds throughout the forest in which it is found. It is much more expensive to work such timber out to the streams than it is to work the forests of America, where the trees grow nearer together and roads are constructed by which the entire product can be removed.

It is this heavy timber thus scattered that renders the use of the elephant in the teak forests imperative, for teams of any kind would be prevented from doing the work by the dense jungle. This great beast, accustomed to make his way through the undergrowth, is strong enough alone to handle the logs and work them to the stream. But elephants are expensive and at the same time are singularly delicate animals. On an average, an elephant will work only five hours a day, five days in the week and seven months in the year. And even at this, he must be handled with the greatest care, and the owner is fortunate who escapes with not more than five per cent. loss per annum by death.

Siam furnishes about one-fourth of the teak of the world, and the quality of the teak timber found here probably ranges with the best. It is customary for trade reports to rate it second to Burma teak; but all these reports come from British sources, and British control the teak interests of Burma. The British Admiralty contracts have for many years been placed in Burma, and that department is proverbially slow in accepting a change. Again, greater experience there may have resulted in greater care in manufacturing the product for the market. Be that as it may, the streams that bear the Burmese and the Siamese teak to the seas, pierce the same regions and find their product in the same forests.

The teak forests of Siam are situated in the upper provinces at a distance of several hundreds of miles from the capital, Bangkok, with which they are brought into communication by the river Chowphya, commonly called the Menam, and its tributaries. In these forests, which are leased for terms of years to the up-country traders, the trees are first "girdled"—that is to say, at the proper season of the year the bark and sap are cut through all round the trunk close to the ground, in order to make the wood lighter and better for land and water transport before it is carried away, and to prevent what is known in America as sap rot. This is rendered unnecessary in countries where the cold of

winter drives the sap out of the trees and thus prepares them for the lumberman through nature's own process. This operation must be completed at least two years before the trees are cut. The trees are then felled at the proper time and made ready for transport. They are afterwards hauled by means of elephants to the creek or small stream which is nearest to them. These several operations, girdling, felling, and transporting to the creek, require a period of about three or four years; but it is after the butts reach the creek side that the most formidable causes of delay begin to operate. Even if the season should be favourable and the brooks full of water, the logs float at a slow pace down them, and have to be worked forward with the aid of elephants by the process called "ounging" until they reach the larger streams. Here, their progress is impeded by blocks and obstacles of all kinds, and the assistance of elephants is still needed. The transport of a number of logs, after arriving at the larger streams, to the rapids, about 150 miles, requires on an average four months in a good season, and thence downward to Bangkok seven to ten weeks. Under the most favourable circumstances they may reach Bangkok in six months from the time of arriving at the main streams, or three and a-half years from the time of being girdled in the forest.

Unfortunately, it is by no means in every year that there is enough water in the creeks to float the logs at all, and still less certain is it that they will be floated as far as the deep stream before the floods subside. Out of ten years there will not usually be more than two or three when there are full floods, and three or four when there are floods of average height and duration. The other three or four or even five years will be "dry" years, and will only permit of a very small quantity of wood being brought out of the forests.

Thus, taking one thing with another and allowing for the average delay caused by more or less dry seasons, it appears that from the time when money begins to be expended upon a teak tree until it arrives in Bangkok and can be exported, a period of from three and one-half to seven years, or even more must elapse, during the whole of which money continues to be expended on the tree, either in working it or watching it, while no returns can be had. Besides the actual expenses of felling and transporting by land and by water, there is the royalty to be paid to the lessor of the forest and the Government royalties payable on the main river. It is also necessary to keep a considerable staff of watchers to guard against the continual pilfering of logs and against fires.

From the foregoing it will be easily conjectured that a very large capital is needed for persons engaging in the up-country teak trade, and the capitalists who embark in this business must be content to see their money locked up for a long time before profits can come in. If a bad year, *i.e.*, a

dry season, should occur, no profit can, for the time being, be expected; and if this should be followed by second bad season, it will be impossible either to make any profit or even to pay the interest on the capital expended. Hence it happens that in contracting loans in this business and making arrangements with the lessees of forests, a long period of years is included in the compact, so as to allow of the very gradual repayment of the sums advanced. In many cases, no interest is paid upon such loans for several years, while the wood is being worked down to Bangkok, and then, out of the ultimate proceeds of sale, are paid at length arrears of interests, which reach sometimes an almost incredibly large sum. If a season is good, the trader pays the interest readily and willingly; if it is bad, he is obliged to hold it over, much against his will, for the rate of interest is heavy in Siam, and, in the case of many *traders* who are "men of straw," exorbitant.

As it is with the lessees and head contractors, so it is with the sub-contractors and foresters. These latter invariably obtain advances from the lessees and repay them in kind, with interest in good seasons. It is an unheard of thing for these people to pay interest in money; and a lessee who attempted to enforce such payment would not only fail to obtain it, but also forfeit his chance of obtaining contractors in the future. On the contrary, when the interest on loans to sub-contractors is unpaid owing to dry seasons, it is necessary to advance them fresh capital in order that they may be able in a better year to deliver the wood which they owe.

The logs when felled and before being transported are stamped with the owner's hammer mark. Having reached the creeks and having been floated down river past the rapids, they are made up into rafts which are despatched *en route* to Bangkok in charge of raftsmen who understand the business and generally work for a single employer, between whom and themselves there is mutual confidence. The task of these men as well as of those who work the logs down to the making up stations, is one of great responsibility. They have to contend with the great difficulties of navigation and to guard against the machinations of timber thieves who infest the water courses. Occasionally, notwithstanding the utmost vigilance, a raft will break up; and then an immense amount of energy is required to collect the logs and save them from plunder. One of the most important advantages of an up-country teak trader is that of being always able to command the services of able and trustworthy rafters, and one of the most serious injuries which anyone can inflict upon a lessee is to destroy or impair the confidence of the rafters in his credit and projects.

The teak trader must also find and keep reliable and well-paid agents at the principal towns on the river where the rafts are made up, and at the station where the duties are levied. He

must, during his visits to Bangkok and to places within his districts, intrust his valuable elephants and other movable property to the charge of employés who, if not punctually paid, are apt to levant with the animals or other things and sell them at more or less ridiculous prices for their own benefit.

In short, the teak trader of the forest must have at his command a very large reserve of capital, to be employed during bad years in keeping up the huge staff which is absolutely necessary for successfully carrying on his business.

The cost of working teak in Siam has been greatly enhanced during the last ten years. The royalties to the Government have increased 200 per cent., the price of elephants has increased over 100 per cent., and the cost of labour to work the forests has advanced over 200 per cent.; and to this increase has been further added a heavy difference in exchange which works to the disadvantage of the producer.

The limited area of the forests from which the supply for the future must come, the restrictive measures now being imposed by the Government on those working concessions already granted and the refusal to grant new concessions, and the increasing demand year by year, together with abovementioned advance in cost of production, argue a material rise in the prices of teak in the near future. Notwithstanding all this, prices are ranging comparatively low just now, because of large purchases having been made in anticipation of this expected advance, and because the past season has been phenomenally favourable for bringing teak down to the market.

Again, the teak market of the future promises to be more steady than it has been in the past, because of the elimination of the small traders from the business. There were many of these in the earlier days, but they have been gradually crowded out by the circumstances already mentioned in the report. These small traders, being unable to hold their product for any length of time, were obliged to sell when their rafts came to the local market for whatever prices they could realize; and on account of the large number of these men in the trade, this often caused a decided fluctuation in the market.

Beyond the head waters of the Menam, in Northern Siam, and on the other side of the divide which forms the water head that separates the waters of the Menam and the Mekong rivers, are large tracts of virgin teak forests of splendid quality. The Mekong penetrates this region 2,500 miles from its mouth; but its rapids and waterfalls render rafting impossible, and must prove destructive to individual logs in their journey to the sea. Thus shut off from approach from the north and inaccessible from the south because of the mountain range, these valuable forests will probably remain undeveloped for years to come—buried treasure for the future of Siam.—*Scientific American Supplement.*

The Expansion of Coniferous Forests.

In the monthly record of the April 1901 Number of the Geographical Journal, there is a review of a study, on "The Woods of the Thuringer Wald," by Luise Gerbing in the "Mitteilungen des Vereins für Erdkunde zu Halle" for 1900, in which is *remarked :—"The most salient fact brought out by the study is* that of the rapid extension of coniferous, at the expense of deciduous forests—an extension which promises to continue in the future, though at present it has hardly effected a radical transformation in the conditions in the Thuringer Wald.

The above is equally applicable to the coniferous forests of Kashmere, as there would appear to be but little doubt that these species are gradually filling up areas which were formerly blanks and are making their presence felt slowly where deciduous trees have been the principal species. Blue Pine (*Pinus excelsa*), being a prolific seed-bearer, is the chief factor in this movement and is closely followed by deodar, but the former generally shows itself first. There is ample proof of this expansion at the edges of the forests, where it will be found that in suitable localities groups of young plants and seedlings exist where there are and have been no mature trees.

It is also noticeable that in this expansion deodar in favourable localities will hold its own against all-comers, including the quick-growing Blue Pine. Whether this gradual extension of conifers at the present day *in Kashmere is due only to the* prevention of fires (not grazing as there are no rules existing, allowing the Forest Department to check or control it in any way), or whether it shows that these species are of more recent development than deciduous ones, is difficult to say and can only be proved by comparison with other similar forests in other parts; but, judging from the general aspect of coniferous forests in Kashmere, they would appear, many of them, to be comparatively young.

E. RADCLIFFE,
Divisional Forest Officer, Kashmere.

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A Bonny Forest.*

BY A. SCHAEFFER.

AT an altitude varying from 2,200 to 4,200 feet in the valley of the Fier, on a steep slope overlooking the small town of Thônes, prim Chef-lieu de Canton of the Haute-Savoie, there is a dense wood which, though of the small area of 321 acres, well deserves to be written about.

The property of the town, the wood is streaked with any number of paths of gentle gradient laid out at the instigation of M. l'Inspecteur Gumier, which permit of its being gone over without any feeling of fatigue. An excursion to the Canton du Mont is a perfect promenade for those tourists who are attracted in summer by the freshness of the climate, and who will surely become more numerous still, when the Municipality shall have realised their dream of turning Thônes into a great aerotherapeutic station.

For the Forester the charm of the place is magnified by the interest afforded in studying the wood. But for certain scarped ravines, at the bottom of which torrents roar and remind that one is in the Alps, it would be easy to imagine oneself in the midst of the Jura. As a matter of fact, the walks lead through plantation-like high forests of Spruce and of Silver Fir, sometimes complete and regular, sometimes judiciously thinned out by selection fellings, which would not be out of place in the classic regions of Pontarlier and Morteau.

A few figures may best describe the vigour of the wood. A recent enumeration established the fact that the Canton du Mont contains 42,962 tons of Spruce and Silver Fir, or approximately 140 tons to the acre if deduction is made for ravines and a small compartment stocked with beech. In 1884 this same wood only contained 38,597 tons, and the growing stock has therefore

* Translated by H. from the *Revue des Eaux et Forêts*, No. 12, 15 Juin 1901.

increased by 3,365 tons, which added to 5,199 tons exploited, gives a production of 8,564 tons in 16 years, say 535 tons a year or 85 cubic feet per acre a year. During the same period the volume of the old trees of, say, 18 inches in diameter, which in 1885 did not exceed that of the trees of medium size, has now so increased that it is, in regard to their volume, as 37 : 23. The normal state has about been reached, and it can be said that at the commencement of the 20th century the wood is in full production.

This result is the more remarkable because in 1840 the Canton du Mont had so deteriorated in consequence of ill-considered fellings, that it was seriously proposed to make the best of the almost denuded slope by turning it into a goat-run. To-day this lost pasturage for goats is worth some £40,000 sterling, and 60 years have sufficed to accumulate this heap of wealth.

Nature has been ably seconded, it must be admitted, by the wisdom and thrifty tendency of the administration of the town of Thônes, who have pushed their self-denial to the very limit of not taking a single cubic foot out of the 'Reserve' set aside during the rotation which has just been completed. But it would be quite wrong not to applaud to the echo the enlightened competency of the foresters who have managed the wood, and thanks to whom this prodigious growth of wood and of capital value has been obtained.

Numerous agents have succeeded one another, both at the head of the charge of Annecy and at the district of Thônes. They had not all had the same way of looking at things in point of view of organisation; some favoured the selection method, while others were for a full high forest; but one and all steered clear of any exaggerated view, as well as of any hard-and-fast dogmatism. Those who practised selection fellings have carried them out prudently, and not feared to thin the regular thickets which they came across; while those who have directed the regeneration fellings have never gone as far as the final cutting. The consequences of this freedom of action, intelligently applied, and carried out under cover of the selection method, have been of the happiest. The beautiful appearance and the almost uniform richness of the compartments in Canton du Mont superabundantly prove it.

A visit to the wood will convince the most sceptical of all the good that can be done by applying a method so elastic. Thinings, seed-fellings, extractions, everything comes under the modern selection method. Of astounding plasticity, this method of treatment bends and lends itself to growing stocks of great diversity; the cultural instinct is above all, and in conforming to it one is sure to do well.

• An editorial footnote explains that it is not the modern selection method, but the regular method which has been described such as it has been applied in the neighbourhood of Pontarlier and of Morteau for half a century. Be that as it may,

the results are most remarkable for forests at a considerable elevation in the mountains of Europe.

Malaria

Malaria.

In recent years it has been discovered that malarial fever is caused by a parasite which undergoes two alternating generations, one within the human body and the other within the body of certain species of mosquito.

Dr. Laveran first detected, in November 1880, the presence of peculiar bodies, both pigmented and non-pigmented, in the blood of malarial patients.

The idea that mosquitoes were the source of malarial infection arose from analogy with what Dr. Manson had already observed in the case of filariasis.

The valuable investigations made by Major Ross in 1897 confirmed the mosquito-malaria theory; and the knowledge then acquired has been extended by the researches of Professor Angelo Celli, Director of the Institute of Hygiene, University of Rome, and by the labours of the Italian Society for the Study of Malaria, and of the Liverpool School of Medicine.

Forest officers in India, and more especially those who are fated to live and work in malarious localities, will read with great interest Professor Celli's "Malaria," translated from the second Italian edition by Dr. J. J. Eyre (Longmans, Green & Co.).

The malarial parasite belongs to the class, *Protozoa;* Order, *Sporozoa;* and has been provisionally placed in Sub-order *Hæmosporidia.*

The dimorphism or alternating generation consists of—

1. An asexual cycle completed within the body of man.
2. A sexual cycle completed within the body of the mosquito.

In the first cycle the parasite commences as a sporozoite, gymnospore or amœbula, consisting of a cell containing protoplasm with a nucleus and nucleolus. This attacks and destroys the red corpuscles of the blood. The febrile stage corresponds to the development of these cells, which, after producing within themselves a large number of amœbulæ, burst and allow these bodies to escape. Each amœbula then attaches itself to a red corpuscle, and in course of development produces other amœbulæ as before.

In the second cycle other sporozoites or amœbulæ develop into larger bodies, which are called 'gametes.' The gametes are either male (spermoid) or female (ovoid). When the mosquito has sucked the blood of a malarial person, the gametes pass into the middle intestine of the insect and there unite, the spermoid entering the ovoid and forming a zygote. This produces within itself an enormous number of fusiform bodies, about 10,000; and when the zygote bursts these bodies (amœbulæ) accumulate about the salivary glands of the mosquito and are then ready to enter

the human body through the punctures made in the skin by the insect, and to re-commence the first cycle.

Some febrile diseases of birds, dogs, horses and other animals are also caused by hæmosporidial parasities, which pass during the second cycle through the bodies of certain species of mosquito, but which are innocuous to man.

The mosquito, the definitive host of the malarial parasite of man, belongs to the Order, *Culicidæ*, which has three genera: *Culex*, *Anopheles*, and *Aëdes* (the last mentioned not found in Italy), and of these *Anopheles* is the only genus that harbours the malarial parasite of man.

In *Culex*, the innocuous genus associated with *Anopheles* in malarious localities, the palpi are very much shorter than the probocis; the larvæ have the breathing tube in the tail, and assume an oblique position, head downward, when they come to the surface of water to breathe; the eggs also are laid in groups of 100 to 200 or more in clear or muddy water.

In *Anopheles*, the palpi are as long as the proboscis; the larvæ have breathing tubes in the back, and assume a horizontal position when they come to the surface of water to breathe; and the eggs are laid in groups of 5 to 20 in clear water.

The particular species (and this refers more especially to those of Southern Europe) that harbour the malarial parasite of man, are:—

1. *A. claviger* vel *maculipennis.* Each wing with four black spots arranged in the form of a capital T.
2. *A. bifurcatus.* The wings without spots.
3. *A. superpictus.* Four black spots arranged in a line along the anterior or external edge of the wings, with intermediate spots of a yellow colour.
4. *A. pseudopictus.* The same as No. 3, but the four black spots not so distinctly marked.

The eggs of the malarial mosquito in Italy are laid from April to September, the period of hibernation extending from November to March.

The eggs are laid in still or slowly-moving fresh water, and take 30 days to become perfect insects, and these after 20 days begin to lay. The larvæ live in water, feeding on vegetable matter, and coming to the surface to breathe. The perfect insect lives entirely in the air, and feeds on vegetable juices and blood. It lives and hibernates either in houses (*A. claviger*) or in trees (*A. bifurcatus*).

The measures proposed by Professor Celli to combat the disease are, chiefly:—

1. Isolation of infected patients.
2. Use of disinfectants against

   (*a*) the parasite in man;
   (*b*) the malarial mosquito.

3. External protection of the human body.
4. Removal of local predisposing causes.

1. *Isolation.*--As an infected person in a malarious locality may either infect other persons through the agency of mosquitoes, or be himself re-infected during treatment, it is necessary to isolate him by removing him to a non-malarious locality until a microscopic examination of his blood shows that he is completely free from the disease.

2. *Disinfectants.*—Remedies found to be efficacious when given internally, were: quinine sulphate, potassium bromide and iodide, arsenic, *antipyrin*, *methylene* blue, phenocoll and euchinin; and by subcutaneous injection, carbolic acid; the best results accruing from euchinin, methylene blue, and quinine.

Quinine, *in sufficiently large doses*, kills the protoplasm of the parasites, and causes their expulsion *from the red corpuscles.*

The best time to administer the drug is immediately after an attack during the sweating stage; but it may be given with advantage just before an attack, as it then has the good effect of preventing or reducing the formation of the "gametes," on which after their formation it has no influence.

The larvæ and nymphæ may be destroyed by adding to the water in which they live the following substances in order of efficacy, *viz.*, saturated sulphurous water, permanganate of potash, saturated solution of salt, chrysanthemum powder, larvicide aniline dye, saturated solution of tobacco leaves, petroleum, ammonia, oil, etc.

The vegetable disinfectants which, with the addition of those already noted, were tried with a certain measure of success, were saturated solution of Valerian root, of Quassia amara, Solanum nigrum, and of *Daphne Gnidium.*

To destroy the mosquitoes the following odours, fumes and gases were successfully tried, and are given in their order of efficacy: *odours*—oil of turpentine, iodoform, menthol, nutmeg, camphor, garlic, pepper, naphthalin, onion; *fumes*, tobacco, pyrethrum powder, larvicide, eucalyptus leaves, quassia, wild mint, pitch, rosemary, camomile flowers, salvia, common wood; *gases*—sulphur dioxide, hydrogen sulphide, ammonia, and common gas.

3. *External protection.*—Stout clothing is recommended to resist the attacks of the mosquitoes, and to prevent chills. Effective local applications to the exposed parts of the body are: pomade of valerianic acid; and soaps containing extracts of tobacco or of *turpentine.*

4. *Removal of predisposing causes*:—The following measures, which have been tried with complete success in the Roman Campagna and other parts of Italy, are recommended; disforestation of the locality, as trees shelter the insects; thorough surface and sub-soil drainage; deposition of ordinary earth or of alluvium to raise the ground level; erection of suitable houses;

fitting of doors and windows with wire-gauze screens; use of mosquito nets; supply of information to those living in malarious localities as to the cause of the disease and the best measures to be taken for its prevention.

The majority of forest officers are exposed to the danger of contracting malarial fever. In the light of the knowledge we now possess, they should be able to take measures, on behalf of themselves and of their subordinates, to render forest stations in the heart of malarious localities comparatively healthy, and to reduce the ravages of what is admitted to be one of the most fatal scourges of this country.

R. L. HEINIG,
Dy. Conservator of Forests.

ANDAMANS.

VI.—EXTRACTS NOTES AND QUERIES.

Note on the cultivation of Elettaria Cardamomum.

Soil.—The soil ought to be richly loamy, free, capable of holding a sufficient quantity of moisture and containing a good percentage of leaf mould. A rocky soil is very detrimental to its well-being.

Climate.—This exercises a great influence on the cardamom plant. A heavy or a light monsoon brings about a bad crop. Continued drought from February to May does not affect the plants much, but the yield will be small. February rains do immense good. A moderate and well-distributed rain is what the plant likes and produces a good yield. Fire, it need not be added, kills the bulbs outright.

Aspect.—This should be such as the direct rays of the sun do not strike the ground of the cardamom garden. Northern and western are the most beneficial; but a north-eastern or a south-western does not do great harm. The ground should not be exposed to the effect of strong winds.

Altitude.—This ranges between 1,800 feet to 5,000 feet. Those growing on and above 2,000 feet thrive best. Watt (Dic. of Eco. Pro., Vol. III, p. 228) gives the altitude to be 2,500 feet to 5,000 feet; but I have known rich gardens growing below an altitude of 2,300 feet.

Cultivation.—The two chief modes of cultivation are by bulbs and by seeds. To start a plantation, the ground should be first cleared of all undergrowth, and big trees of different species felled here and there to admit sufficient light and air. The seed is then sown broadcast. If the ground is slightly prepared

preparatory to sowing, better results are sure to accrue. After the first monsoon the plants attain a height of 2 or 3 feet. Weeding is absolutely necessary in the first and second years; and in the third and succeeding years till the plants bear fruit this operation may well be dispensed with. Fruits begin to appear in the third year; but profuse and profitable seeding commences in the fourth or fifth year. Weeding is necessary in all the subsequent years, and a neglect of the operation surely leads to deplorable results.

In the propagation by bulbs pits of about one foot deep and 18 inches wide are dug in beds slightly raised above the surrounding ground; and into these the bulbs are transplanted. Here, as before, the ground must be cleared of all undergrowth and the canopy slightly opened out to admit sufficient light. Fruiting in this case is sure and profuse in the third year. Here, as in the other case, weeding is indispensable.

A garden which had been yielding good results, but which had been, through carelessness and neglect, left uncared for, has been known to be treated in the following method with excellent results:—

In summer the undergrowth is cleared and big trees are felled at random to admit light and air. In the succeeding autumn young plants come up in numbers in places exposed to light and especially on either side of the fallen stems. Natives assign this not to the clearing of undergrowth and the admission of light, but to the so-called 'shaking of mother earth' caused by the fall of gigantic trees. Whatever it might be due to, the results are satisfactory. Great care should be taken in this case as elsewhere, not to open out the leaf canopy too much, as by doing so the young cardamom plants may be overtopped and choked up by the profuse appearance of injurious growth.

Yield.—According to Watt (Dic. of Eco. Pro.) 28lbs. per acre in Bombay Presidency seems to be the highest on record. But instances are not wanting in Southern India of gardens yielding 5 thulams, *i.e.*, 100lb per acre. This might be an exceptional example, but $1\frac{1}{4}$ and $1\frac{1}{2}$ thulams, *i.e.*, 30 and 25lbs., per acre are very common. At any rate, the yield would surely justify the outlay of a small sum for the culture of cardamoms; and it is curious to see that productive lands are allowed to remain fallow and that those Governments which have every facility for cardamom culture are apathetic towards that industry.

THANIPADOM: 20*th June*, 1901.

K. G. MENON,
Cochin Forest Service.

"Fire Lines in Pine Forest in Prussia."

PINE forests are in all probability the most easily set on fire, and this is specially true of those growing on sandy soil. Such forests form the chief stand of the district at Chorin, a little

village near Eberswalde in Prussia. The pines (*Pinus sylvestris*) are growing in clear stand on a sandy soil, presumably the delta formation of the under ice-streams of the glacier that once covered the region. The stand is especially endangered by the main line of railroad from Berlin to Stettin; but despite these conditions, there have been very few serious forest fires in it. That there have not been more is due solely to the excellent system of fire lines which cut up the stand into small sections and successfully prevent the spreading of any fire that may start.

Adjoining the line of the railway, and running parallel to it, is the main fire line. This is a strip about thirty-five feet wide, on which a number of trees are kept as "spark catchers." The trees used for this purpose are of various genera: birch, beech, pine, &c.; but the forester in charge gives the pine the preference, as it is evergreen and consequently of greater service in the early spring when the danger from fire is greatest. The trees are kept clear of branches for at least two to three feet from the ground, and the ground-covering is of grass or some low-growing green herb. All dry material and all weeds are carefully removed. These precautions are taken to prevent the fire from making rapid headway. Back of the strip just described is a shallow ditch some four feet in width, which runs parallel to the track. This ditch is very carefully freed of all growth whatever, and from two to three times in the course of the spring and summer the earth is loosened, so that the fresh broken soil is always exposed. The strip and ditch together form the regular form of fire line along railroads, and are excellent in preventing large fires. Suppose that a spark alights in the ground-covering and this takes fire, there are no dry lower branches nor any weed growth which can furnish fuel to the fire, so that it runs but slowly. If the fire is not discovered and put out, it finally reaches the ditch, and there, not having previously attained any size, it is unable to get across, and therefore burns itself out.

In those localities which are most endangered by the trains, a further system of fire lines is employed. This extra protective belt occurs back of the beforementioned ditch. A section of the normal stand is divided by four-foot ditches similar to the first, into squares with a side of about thirty feet. The area embraced within these squares is kept free from all such things as fallen branches, dry grass, and the like. The ditches are swept clear of all pine needles and other easily inflammable stuff, and the ground is kept bare by hoeing. This extra protective belt prevents the spread of any fire which starts within the ordinary fire line beside the railway, and is only a necessity in especially exposed localities where sparks are liable to be blown beyond the ordinary lines.

In the interior of the stand still another protective system is employed. This consists of a series of roads which intersect the stand, forming a sequence of squares the sides of which are about

seventy yards. These roads are twenty feet in width; are ploughed up each spring, and are then sown down with ceradella, a low growing Spanish plant belonging to the pea family (*Leguminosæ*) and similar in habit to the common vetch (*Vicia sativa*). Ceradella is a very close grower and seems to thrive on all soils and to keep fresh and green in the worst droughts. Consequently it is eminently fitted for the prevention of the spread of ground fires. Such roads planted with ceradella serve to check intra-stand fires before they obtain great headway, and in case a fire has got beyond control they give the fire-fighters a point from which contra-fires can be started.

Such is the complete system of fire lines in use in the district, and by means of them a stand very exposed to danger from fire has escaped all large fires for a long period of years. The railroad bears a large part of the expense of the formation of the primary fire line as well as its entire cost of maintenance, the secondary belt and the fire roads are paid for by the Department of Forestry.

For many of the details contained in the foregoing, I have to thank Herr Forstmeister Dr. Kienitz, who has charge of the district, and who very kindly accompanied me through his interesting revier.—*The Forester.*

Logging in the Redwood Forests of California.

AMONG the many natural wonders of Western America are the forests of giant trees which cover the lower slopes of the rocky mountains, the Sierra Nevada and the Cascade Mountains, and the coast ranges which reach from the Columbia River down through Western Oregon and California. To a traveller from the Eastern States there is no feature of the country lying between the Pacific Ocean and the Rocky Mountain range which creates so strong an impression as the size and character of the forest timber. The oak, the maple, the elm, and a dozen other varieties which are familiar to residents in the country east of the Alleghenies, cease to form a feature of the landscape, and as the train climbs the eastern slopes of "the Great Divide," the traveller catches his first glimpse of the giant trees of the West, the rounded and gentle outline of the densely-massed foliage of Eastern trees being replaced by the tall and sentinel-like forms of the Redwood of California and the pine and fir of Oregon and Washington. The finest specimens are to be found in the large groves, where the trees are closely massed, their huge trunks, from 10 to 25 and even 30 feet thick at the butt, rising perfectly plumb and without a limb for from 100 to 150 feet to the first branches, many of which are thick enough to form a massive tree in themselves. The largest specimens of California trees are found in the famous groves at Mariposa and Calaveras, where specimens of the *Sequoia gigantea* with a diameter of 30 feet at

the butt were not uncommon when the grove was first discovered, while the height of these truly wonderful trees was frequently over 300 feet, and is even estimated to have been in some cases as great as 400 feet. The two most celebrated varieties of the big trees of the West are the Douglas fir found in the immense forests which abound in Washington and Oregon, and the Redwood trees of California. The Douglas fir is the western counterpart of the Southern pine. Like it, it is admirably suited, by virtue of its great bending strength, for bridge and roof work, and all classes of framed structures, and the Douglas fir of Oregon is likely ever to remain the favourite wood for use in the racing spars of yachts of the larger class. The Redwood trees of California, on the other hand, not only furnish a timber which affords wonderful resistance to deterioration when exposed to the weather, but is possessed of an exceedingly fine and beautiful grain and colour, which makes it a choice wood for the interior decoration of houses. It is very largely used for this purpose in the West, and has become increasingly popular of late years in the East.

A general idea of the enormous amount of timber contained in a tree, measuring like this $16\frac{1}{2}$ feet at the butt, may be gathered from the following dimensions :—

The total length	300 feet.
Length from butt to first limb	150 ,,
Diameter at butt	$16\frac{1}{2}$,,
Average diameter of logs	12 ,,
Full contents of logs in board measure ...	166·125 ,,
Weight of logs estimated at $4\frac{1}{2}$ pound per foot, board measure	273 tons.

Bark on the tree, 6 inches in thickness. The number of days from the time the choppers commenced until the tree was made up into logs ready for transportation, was four and three-quarters. As the largest logs were split in the woods before transportation, it took nine logging cars to haul the logs to the mill. After communication with a belt of timber has been established, these noble trees, the lives of many of which are measured by the thousand years, begin to fall beneath the axe and crosscut saw. One cannot but feel on sentimental grounds the deepest regret that these stately and monumental specimens of tree life should be so ruthlessly swept away, and the pity of it all is only partly mitigated when we remember that the timber thus cut up is turned to a thousand valuable commercial uses. In felling the trees a cut about half-way through is made on the side of the tree towards which it is to fall, and the tree is then sawn through from the opposite side. This is in the case of trees of only moderate dimensions; in the cases of the larger trees the crosscut saw is used more freely. The falling of a 250-foot tree is a thrilling sight, never to be forgotten. The first warning is given by the crackling of the fibres, as the saw cuts away the small remaining

wood that keeps the tree up. The top of the tree is then seen to move slowly across the clouds as the giant bends slowly to its fall.

With an angry "swish" and increasing momentum it describes a giant quarter circle to the ground, the blow of its 200 to 300 tons of weight making the earth tremble as from an earthquake shock. The logs are of unusual size, the majority of them running from 5 to 16 feet in diameter. For convenience of handling all of the logs over a certain diameter are blasted into sections with powder before they are shipped down to the mills. The logs are hauled to a logging railroad by means of a portable engine which, for convenience of transportation, is bolted to a sled. When it is desired to move this sled, the wire cable is run through a pulley which is attached to a convenient tree or stump, and brought back and fastened to the sled. By winding in the cable the engine is drawn to the desired position. When the logs are to be moved, the sled is chained to a tree, and the hauling is accomplished by running a steel rope through as many steel pulleys as may be required. The logs are hauled to the railroad over chutes formed of two parallel lines of logs or poles laid on the ground and freely greased with tallow. They are taken down by the railroad to the saw-mill and worked up into merchantable lumber.—*Scientific American Supplement.*

Extract from the Report of the Committee of the Society of Arts on Leather for Bookbinding.

TANNING.

The vegetable tanning materials now used in the production of leather are very varied, and probably their active principles, the tannins, form a considerable class. Though their chemical constitution is still only partially understood, it is known that they may be divided into two groups, one of which contains the *dihydric phenol catechol, and the other the trihydric phenol, pyrogallol*, and these groups are characterised by very considerable practical differences. The catechol tannins, which include quebracho, gambier, larch, hemlock, mimosa, and turwar (*Cassia auriculata*) barks, part readily with water when exposed to the action of light, heat, and acids, becoming converted into red resin-like products. We have found that leathers tanned with these materials, although originally strong and tough, are particularly prone to a sort of red decay, which is much hastened by the presence of acids and the action of light, heat, and gas-fumes, and which totally destroys the tenacity of the leather. After a very large number of experiments, we most unhesitatingly condemn all these catechol tannages for bookbinding and upholstery, however suitable they may be for other purposes.

This brings us to the consideration of the many thousands of skins which come over from India tanned with turwar bark. These are bought on the London markets by the leather dressers, and are usually detannised by scouring, or drumming in an alkaline solution, next treated with sulphuric acid to brighten their colour, and re-tanned in sumach, after which they are finished and are usually sold under the name of "Persian moroccos" or "Persian sheep." For cheap bookbinding purposes this leather has been used most extensively, and in all our numerous investigations no leather has proved so inferior in resistance to decay as the re-tanned Persian. A book bound in Persian morocco or in Persian sheep shows signs of decay in less than twelve months, and from our experiments we are inclined to believe that no book bound in these leathers and exposed in a library on shelves where it could be affected either by the sun's rays or by gas-fumes, could ever be expected to last for more than five to seven years. The leather, as imported, will redden perceptibly with a single day's exposure to sunshine! In visiting numerous libraries we found that more than half the modern bound books which were in a bad state of decay had been bound in Persian or East India-tanned goat and sheep. We cannot emphasise our opinion too strongly on this subject. We should unhesitatingly advise that in all contracts and specifications for bookbinding, the use of East India-tanned goat and sheep, whether re-tanned or not, be absolutely forbidden. Similar objections apply with almost equal force to the use of mimosa, hemlock, or larch, or of quebracho wood or extract, as tannages for bookbinding leathers. Gambier is also objectionable, while oak-bark, valonia, and oakwood extract, which probably contain tannins of both groups, have proved tolerably permanent.

The pyrogallol class of tanning matters, which comprises gallnuts, sumach, myrobalans, and pomegranate rind, has proved to yield leathers much more resistant to decay under library conditions than the catechol tannins, and of all these pure sumach is the tannage we would most strongly recommend for high-class bookbinding. We have tested leathers tanned with every common tanning material as regards resistance to the action of light, heat, gas-fumes and oxidising agents, and none has stood the test so well as pure sumach tannage. It is almost certain that all the early Italian moroccos which have shown such remarkable permanence are of sumach tannage, and the Niger goat skins are either tanned with sumach or some closely allied substance. The sumach which is imported into this country is very frequently mixed with cheaper materials, such as "tamarix" and "pistacia." When one or both of these materials are present in the sumach, the effect makes itself apparent on the finished material by reducing its length of life, as both these adulterants belong to the class of catechol tannins which we have unhesitatingly condemned.

It must be clearly understood that our condemnation of the catechol tannins refers only to leathers expected to withstand the action of light and air for long periods, and protected from weather. In resistance to wet and *mechanical* wear, many catechol tannins are superior to sumach.

PRESERVATION OF BOOKS.

Much light has been thrown on the influence of various outside conditions existing in libraries on the durability of leather, by a series of very careful experiments made by the Committee. These experiments prove conclusively that the acid-fumes of burnt gas are the most fatal of all the influences to which bindings are ordinarily exposed, producing what has been described as "red decay" on every sort of leather to which they have had access, the effect being most marked on the East India tannages and other leathers made with tannins of the catechol class; and least so upon these with sumach and other tannins, such as myrobalans, which are known to be pyrogallol derivatives, while oak-bark occupies an intermediate position, both practically and chemically. It was shown that 30 days' exposure to the fumes of a very small gas jet rendered East India leather (tanned with turwar bark) perfectly rotten, so that the surface could be scraped off with the finger nail, while on leather tanned with sumach it had comparatively little effect. Similar experiments were made with exposure to sunlight during 30 days of the past summer, and in this case again, the leathers were affected in the same order: turwar, quebracho, larch bark, and gambier being among the worst; and sumach and myrobalans the *least* affected, while oak-bark as before occupied an intermediate place, being somewhat darkened but comparatively little tendered. It was found that serious effects, very similar to those of light, were produced by exposure during 30 days to air at a temperature not exceeding 110° to 120° Fahr., dry air being apparently slightly the most deleterious.

GENERAL CONCLUSION.

To sum up the experimental work as far as it has gone:—

1. It is shown conclusively that the catechol tannins, which include turwar, quebracho, hemlock, and larch barks, and gambier are unsuitable for bookbinding leathers where durability is expected, and that sumach yields a much more permanent leather, while myrobalans occupy an intermediate place, but nearly approaching sumach. It is unfortunate that *cassia* bark, which is the tanning material employed for East Indian sheep and goat skins, should have proved so unreliable, since these leathers have been largely used in bookbinding without suspicion, and are in other respects a cheap and good article. With regard to sumach leathers themselves, it is possible that some of the darkening noticed may be due to the presence of adulterants, such as pistacia leaves, in the

sumach used, as it is almost impracticable to obtain absolutely pure sumach, and the pistacia tannin is allied to that of the *cassia*.

2. Of all the influences to which books are exposed in libraries, gas-fumes—no doubt because of the sulphuric and sulphurous acid which they contain—are shown to be the most injurious, but light, and especially direct sunlight and hot air, are shown to possess deleterious influences which had scarcely been suspected previously, and the importance of moderate temperature and thorough ventilation of libraries cannot be too much insisted on. —*Journal of the Society of Arts.*

Sal Trees injured by Frost.

Photo. by W. H. Lovegrove.

THE

INDIAN FORESTER.

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Injury by Frost to Sal Trees.

OUR illustration, reproduced from a negative taken by Mr. W. H. Lovegrove, Deputy Conservator of Forests, shows the effects on sal trees of the extraordinarily severe frost which occurred in the Ganges Division of the N.-W. Provinces between the 10th and 19th January 1900, a few days before the belated winter rains commenced.

We are indebted to Mr. F. B. Dickinson for the following description of the locality in which the photograph was taken :—

"The area which was most affected was the valley of the Dhimbi, the easternmost feeder of the Kohtri, in the Chokam Dun, about a mile to west and north-west of the Chokam rest-house. On both sides of the stream is undulating ground, formed of detritus washed down from the hill range on the north, through which the stream has cut a channel of some 80ft. to 100ft. deep. This undulating ground is grass covered, with patches and strips of sal, and is always subject to frost, the effects of which make themselves felt to a height of over 150ft. above the bed of the stream. The lower patches of forest are attacked nearly every year, and the trees are covered with adventitious branches to within a few yards of the ground and have no proper crowns, looking like enormous bottle-brushes. The younger ones are so constantly killed back, partially or wholly, that there seems no chance of their ever growing up, and it is probable that the older bottle-brush trees, of which there are numbers—50ft. to 60ft. in height—must have grown up under more favourable conditions than now obtain.

The forest naturally improves on the higher ground, and there is some chance here of its encroaching on the grass. Last year's frost was, however, much more severe than usual, and extended its ravages to a higher level, greatly damaging patches which had before seemed out of danger. The area affected extends from the base of the hills all along the stream to its junction with the Kohtri, a distance of 1½ miles, and has an acreage of about 4—500 acres. It is, no doubt, its exceptionally sheltered position, combined with its comparative flatness, which renders it so liable to frost. It is in fact surrounded by hills and spurs on all sides.

The severe frosts of last year were referred to in the Annual Report, para. 97. Frost appears to be more severe in dry winters, judging from my two years' experience of these forests. The

winter of 1899-1900 was an exceptionally dry one, there being very little rain after the end of August until the 19th January, whilst the past winter was a decidedly wet one, and we hardly had any frost at all in the submontane forests."

A similarly severe frost occurred about the same time in the Dehra Dun forests, when it reached levels hitherto quite untouched.

The Preparation of Saltpetre in the Southern Shan States, Burma.

THOUGH not strictly a forest product, saltpetre may be included amongst minor forest produce, and as such its mode of preparation may be of interest.

Limestone caves are fairly numerous in certain parts of the Southern Shan States, especially in the State of Möng Pan, bordering on the Salween. Many of these yield an earth rich in nitrates, a kind of guano in fact, the accumulated dung of bats, swifts, &c.

The potash portion (saltpetre being a nitrate of potassium) is supplied by wood ashes. These wood ashes are obtained by cutting up various trees, mainly species of *Anogeissus* and *Lagerstrœmia*, into lengths of about 5 feet, stacking them roughly in the forest and setting them alight.

As the industry is dependent on a constant supply of wood ashes, it can only be carried on during the dry weather, all work ceasing in the rains. The camp is usually on the bank of a stream so as to ensure a plentiful supply of water.

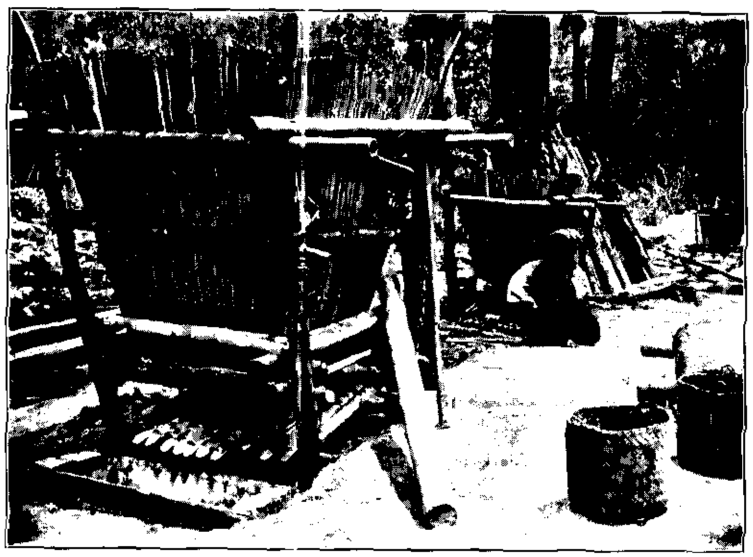
After the guano and ashes have been brought into camp, the former is pounded fine and mixed with wood ashes in the proportion of one basket of guano to two of ashes. The mixture is put into a huge filter made of bamboos and lined with leaves, as shown in the accompanying photograph, and is lightly pressed, after which water is poured in. This percolates through, dissolves out the nitre and drips into a wooden trough. The amount of water poured in depends on the richness of the guano, and so long as the water which drips into the trough is of sufficient strength, determined by taste, more fresh water is added.

The solution thus obtained is then boiled in iron cauldrons until it acquires the right consistency, when it is run through mat filters into bamboo tubes, one foot long and three inches diameter, where it crystallizes. When crystallization is complete, the bamboos are split open and the resulting saltpetre is ready for the market.

The only use to which saltpetre is put is the manufacture of gunpowder; the requisite sulphur for which comes mainly from the Eastern States, though a small amount is also obtained from local sulphur springs.

A considerable quantity of gunpowder is consumed annually in these States in fireworks as well as for firearms, every other Shan being the possessor of a gun of some sort, the Arms Act not yet being enforced.

BAMPON, *15th August*, 1901. W. H. CRADDOCK.



Preparing Saltpetre in the S. Shan States.

Photo. by W. H. Craddock.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Rate of growth of Sal in Thinned and Unthinned Areas in the Central Circle of the North-Western Provinces and Oudh.

Communicated by MR. F. B. DICKINSON, *Conservator of Forests.*

THE figures given below are the results worked out from girth measurements in sample areas in the submontane forests of the Central Circle for different terms of years, ranging from seven to seventeen years. They are especially interesting from the conclusive way in which they show in every case the largely increased rate of growth in thinned areas as compared with that in unthinned areas.

In most cases it is twice as large in the former as it is in the latter, except in the case of the Andhermajhera plots, where the thinning appears to have been a light one:—

(i) Kumaun Division.

Class.	Khonani North, 1 acre plot, thinned 13 years. No. of trees.	Average increase.	Time required to get through the class.	Selani, 1 acre plot, unthinned 13 years. No. of trees.	Average increase.	Time required to get through the class.	Remarks.
		Inches.			Inches.		
Sal IV 0—1′ 6″	5	10·69	22	1	4·90	48	2,000′
" III 1′ 6″—3′	33	6·27	38 } 115	11	1·65	142 } 284	
" II 3′—4′ 6″	21	4·28	55	32	2·49	94	
" I 4′ 6″—6′	12	5·27	44	5	2·43	97	
" IA above 6′	...	...	...	...	...	...	
Total	71	...	159	49	...	381	

Class.	Lakhmanmandi, 17 years. 2 acre plot, thinned. No. of trees.	Average increase.	Time required to get through the class.	½ acre plot unthinned. No. of trees.	Average increase.	Time required to get through the class.	Remarks.
		Inches.			Inches.		
Sal IV	11	11·83	27	16	4·29	70	1,100′
" III	48	12·14	26 } 87	22	8·69	34 } 160	
" II	43	9·86	34	19	5·04	56	
" I	7	9·89	34	2	6·62	45	
" IA	...	...	...	...	...	...	
Total	109	...	121	59	...	205	

Class.	Sanmanthapla 17 years. 2 acre plot, thinned.				½ acre plot, unthinned.				
		Inches.				Inches.			
Sal IV	3	11·88	28	87	16	3·13	98	190	1.100′
" III	46	10·57	29		21	5·75	53		
" II	52	10·22	30		13	7·99	39		
" I	11	9 88	34		3	8·02	38		
" IA	...	...	...		1	1·25	245		
Total	...	...	121		54	...	473		
	Aonla Khera South, Compartment 5, unthinned.				Chilla, Compartment 3, unthinned.				
		7 years.				7 years.			7 years.
		Inches.				Inches.			
Sal IV	7	4·67	23	52	5	3·51	31	78	2,400′–2,800′
" III	99	3·72	29		11	2·31	47		
" II	...	..	...		5	2·77	40		
" I	...	...	...		2	1·25	88		
" IA	...	...	...						
Total	106	...	52		23	...	206		

(ii) GARHWAL DIVISION.

Class.	North Patli Dun 13 years. — 2 acre plot, thinned. No. of trees.	Average increase.	Time required to get through the class.	½ acre plot, unthinned. No. of trees.	Average increase.	Time required to get through the class.	Remarks.
		Inches.			Inches.		
Sal IV	37	7·56	31	97	2·75	85	1,420′
„ III	88	9·39	25 } 81	52	4·2	56 } 141	
„ II	29	9·42	25	...	...		
„ I	3	9·83	24	2	1·33	176	
„ IA	...	...	...	...	...	...	
Total	157	...	105	151	...	317	

Class.	South Patli Dun, 13 years. — 2 acre plot, thinned. No. of trees.	Average increase.	Time required to get through the class.	½ acre plot, unthinned. No. of trees.	Average increase.	Time required to get through the class.	Remarks.
		Inches.			Inches.		
Sal IV	58	12·61	19	142	5·13	46	1,300′
„ III	92	7·75	30 } 68	26	4·07	58 } 141	
„ II	1	12·58	19	2	6·37	37	
„ I	...	...	...	...	...	...	
„ IA	...	...	...	2	3·37	70	
Total	151	...	68	172	...	211	

Class.	Amtanala 16 years. 2 acre plot, thinned.				Amtanala 16 years. ½ acre plot, unthinned.				
		Inches.				Inches.			
Sal IV	1	9·92	29		5	4·15	83		1,800′–1,900′
" III	11	11·87	25	81	30	5·97	57	191	
" II	84	10·68	27		24	6·71	51		
" I	18	10·11	28		3	14·62	28		
" IA	...	...	...		...	...			
Total ...	114	...	109		62	...	219		

Class.	Rehar 13 years. 2 acre plot thinned.				Rehar 13 years. ½ acre plot unthinned.				
		Inches.				Inches.			
Sal IV	17	9·72	24		24	3·34	70		1,000′
" III	81	8·97	26	74	33	5·40	43	150	
" II	29	9·61	24		13	6·39	37		
" I	1	11·58	20		1	4·50	52		
" IA	...	...	...		...	...	...		
Total ...	128	...	94		71	...	202		

(iii) GANGES DIVISION.

Class.	Chaukhamb 12 years. 2 acre plot thinned. No. of trees.	Average increase in 12 years.	Time required to get through the class.	½ acre plot unthinned. No. of trees.	Average increase in 12 years.	Time required to get through the class.	Remarks.
		Inches.			Inches.		
Sal IV	72	6·1	35	21	2·45	88	2,000′
„ III	108	7·4	29 } 94	51	5·29	41 } 163	
„ II	30	7·15	30	18	6·37	34	
„ I	5	5·97	36	1	7·05	31	
„ IA	5	5·54	39	1	5·3	41	
Total ...	220	...	169	92	...	235	

Class.	Andhermajhera 12 years. 2 acre plot thinned. No. of trees.	Average increase in 12 years.	Time required to get through the class.	½ acre plot unthinned. No. of trees.	Average increase in 12 years.	Time required to get through the class.	Remarks.
		Inches.			Inches.		1,100′
Sal IV	20	4·23	51	22	3·01	72	
„ III	114	6·02	36 } 116	48	5·34	41 } 145	
„ II	28	7·45	29	13	6·75	32	
„ I	1	5·6	39	1	8·4	25	
„ IA	...	...	...	...	...	...	
Total ...	163		155	84	...	170	

As would naturally be supposed, the difference is most marked in the younger classes before the trees of the future have got away from the ruck, proving the advantage of early thinnings where this is practicable. Unfortunately the cost of carriage to the market makes it impracticable to thin a large portion of these forests at an early age. The working season is short, barely six months, local means of carriage practically nil, so that it has all to be procured at a distance.

Rates of carriage are, therefore, large, and increase as the season advances; thus it does not pay to export cheap, small timber except from the forests in and near the plains. The only way to get over this disability is to construct tramways from the forests to the railways.

Grouping the sample areas into two series in accordance with altitude above sea level, we find that the average number of years required to get through each class, are as follows :—

Class.	For plains forests and those near the plains altitude 1,000' to 1,400'.		The middle forests above 1800'.	
	Thinned areas.	Unthinned areas.	Thinned areas.	Unthinned. areas.
IV ...	30 years.	74 years.	27 years.	62 years.
III ...	29 "	48 "	30 "	64 "
II ...	27 "	40 "	37 "	55 "
I ...	25 "	40 "	36 "	61 "

These figures are interesting to indicate how the growth falls off in the older classes in the higher forests, but there are not sufficient data at present from which to draw conclusions in regard to the growth in these higher forests. More sample areas are required both in the middle and upper forests up to 3,500'. It has not been possible to calculate the acre increment from the records, because only a portion of the trees are measured in the sample areas, especially in those which are unthinned. This is to be regretted, and I think that in future it will be advisable to record the measurements of all trees in the sample plots. The average height measurement of the trunk capable of yielding timber, and form factors for each class, should be determined in each locality, the results being recorded in the measurement-book. We should then have data to calculate the volume per acre and the increment per acre, and compare the increment in thinned and unthinned forest.

V.—SHIKAR AND TRAVEL.

A Night's Watch.

I COULD not persuade the Pakrind tiger to kill any of my "ties up," though six appetizing baits had been for some days fastened in the most likely places it might be expected to pass by. But its beat was a large one, which contained much undisturbed jungle, where apparently, as it had not killed village cattle for some weeks, it was able to obtain as much food as it needed. There was no water inside the jungle, but, roughly speaking, at the four corners of the area, which was 14 miles long by 10 miles wide, water was to be found. At three of the corners there were small nearly dried-up village tanks, and at the fourth, which was in the hills, was a water-hole fed by a small spring (one of those over which a native *shikari* loves to sit and shoot unsuspecting does and fawns as they come to drink on a moonlight night). My only chance of a shot at the tiger seemed to be to sit over this hole; it was a very remote chance certainly, but there were signs that the tiger had been in the neighbourhood some days before, and as I had to leave on the following day, I felt that I could not go away without having tried every means to bring it to bag. In the previous year

I had tried for it, but had not been able to obtain a shot, though it had deigned to kill one of my baits. A month or two before I tried, it had been fired at, and I think slightly wounded, by an officer of a native regiment who had left the wing he was accompanying on their march on relief along the trunk road some 10 miles away to try for the Pakrind tiger. Baits, beats and bullets were therefore not new things to it when I arrived upon the scene, and it was clever enough to steer clear of all three.

The water-hole was, as I have said, in the hills. All around the jungle had been burnt, and there was little covert between it and the thick grass and tree jungle in which the tiger usually lived, but it was approached by numerous gorges and ravines, and was just the place to which game might be expected to come at night.

About 3 o'clock I left my camp, having sent men on before me with a native *charpoy* which they were to fasten up over the water in the most convenient tree, and about 6 o'clock I reached the place. The water was not very abundant, and what there was, was very black and muddy, and looked most uninviting; but I suppose it contained some saline properties, which are always such an attraction to game. Some twenty yards away from the main water-hole there was a little water in a hole in the bed of a ravine; this was much cleaner-looking, but it did not seem to be resorted to by game so much as the mudhole, around which were innumerable tracks varying in size from those of the little four-horned antelope to the large but old imprint of a big bull-buffalo, and some rather more recent marks of bison. There were no quite recent tiger tracks, but bear and leopard had visited the water on the previous night, and I hoped that even if the tiger disappointed me I might get a shot at one of the two latter animals. My *machan*, which was placed on a tree between the two water-holes, needed some additional screening before I considered it quite hidden, and it was nearly dark before I was settled in it. The moon, which did not top the hills behind me until between 8 and 9 o'clock, was just past the full, but though the afternoon and evening had been cloudless, the night was not to be so. It might certainly have been a much darker night than it was, but every now and then a thick black cloud obscured the moon, and the water, fifteen yards away, was not visible. I do not know who my first visitors were. About half an hour before the moon rose I heard some animals at the water lapping. They seemed smallish, and may have been wild dogs, but they made no sound save the lapping, and next morning I could find no tracks to help me to identify them. As soon as the moon rose, and I could see a little, I had dinner, and as I finished I heard the sounds of a leopard about half a mile off in the valley below. A four-horned antelope that had been for some time near the water, but apparently rather nervous about drinking, at last plucked up courage and waded through the mud to drink, and then the sounds of the leopard were repeated nearer and nearer, it

gave its little barking call and scampered off. The leopard evidently did not want to drink, for though I heard it for nearly an hour, now a little nearer, and again a little further off, it never came within a quarter of a mile of me. The next sounds I heard were most weird. An appalling din arose about fifty yards behind me, as if a number of wild cats were fighting, but they never approached the water; at least I never saw them do so, and their identity remains a mystery. I must have dosed off for a few minutes, for I suddenly became aware that there were some big animals walking about nearly underneath me, and cracking the dead burnt branches as they moved. They were evidently buffalo or bison, but which, I could not determine at first; however, the moon for a minute showed out clearly, and I saw that one drinking at the water was a bison. There were six of them, and they must has stayed at least twenty minutes within thirty yards of me; but it was not light enough for me to make out if there was a really good head among them, but they all looked enormous in the dim light, and it was a strange sensation to be so near to a heard of bison for so long a time without their being aware of my presence; had it been lighter, all their movements would have been visible, and the sight would have been still more enjoyable. Before the sound of the bisons' tread had died away, as they went down the valley, two bears came down from the hill behind me to the water. Of course, they squabbled before they reached the water, and it was the sound of their quarrel that put me on the *qui vive*.

Apparently one of the pair had been worsted, for only one came to the water in the ravine to my left. I could easily make out a large black mass, as the bear walked down the ravine side, and aiming at the front part of it I fired, my bullet fortunately penetrated the lungs and broke up these. To make certain, I fired a second shot which broke the spine, and the poor bear's sobs ceased. Perhaps I ought not to have fired at the bear, but two-thirds of the night had passed and no tiger had appeared, so I took what the gods sent me. There was one more visitor to the water before the night was over, and this was a sambhar stag. I could hear its antlers strike against the low branches of the trees as it came up, and could just see its antlers as it drank, but the moon was much obscured, and I but hazily saw what with better luck would have been a magnificent sight. Then the east began to light up as the sun rose behind the hills, and I climbed down from my *machan* and inspected the bear, which proved to be a young male nearly 5 feet long.

And so the Pakrind tiger still remains to be shot.

LONG TOM.

The Genus Shikari Kashmiriensis.

THIS study is only meant for the tyro sportsman in Kashmir; the information may, however, be useful to others as well.

Having arrived at Baramula, you will here engage a *doonga* or mat house-boat for yourself and a cook-boat for your servants. Round about you on your arrival will be observed men all with huge wallets containing books, which in their turn contain letters from Sahibs, dating from the year one to the present day —some genuine, others apparently bazar-made. It is advisable not to give these gentlemen any encouragement, but to dive into the dâk bungalow precipitately, where you will be safe at all events until you poke your head out again. If possible, eschew the boat with babies, or else you may be tempted to commit infanticide later on. As you are in a hurry you want to start and naturally give orders to this effect, but there is no motion, only a lot of whispering at the back of the boat. Then the head of the family arrives and explains that they have no coolies to tow the boat. If you have any sort of a stick-like weapon, threaten him with it and the effect will be instantaneous; off will go the boat. Father, mother, sons, daughters and babies all taking a turn to tow or paddle. This is the custom. You pay for the boat and the crew has to work it. You will reach "Sopore" possibly by the evening, so pick a nice place to moor your boat, or else it will be tied up for you by a ricketty bathing-machine looking place or by the bridge, both equally filthy and evil smelling. The Woolar lake will have to be crossed to-morrow, so give orders to start at 2 A.M. in the morning and you may get off at 6 A.M. You then order your dinner, and whilst in the middle of soup or first course your nose will be assailed by the most awfully awful stink emanating from the back of your boat. You enquire what it is, and you will be informed that it is the family also having its dinner, cooking its food in fish oil; order it out at once and forbid such a thing ever taking place again with the direst of threats. It is also a good plan at this stage to forbid hookah-smoking in your boat for ever and ever, at least as long as you are living in it; this will save another exhibition of temper later on. You then tumble in, after a smoke, hoping to wake up and find yourself halfway across the lake. It is wonderful how the air makes you sleep, and you open your eyes at 8 A.M., wondering where you are. When you've found yourself you peer outside through the mats, and with an objurgation discover the boat to be still in the same old place. You howl for help, and when quieted down a bit you will screw the information out of the head boatman that there has been a "barra typhoon," and that is the reason they have not moved. As you have been asleep you cannot gainsay this argument, but wonder at the stillness of the atmosphere, and after physical persuasion off you start. Crossing the lake on a fine day is lovely, but dangerous in flat-bottomed boats when at all windy. *Dolce far niente*—it is very nice for the traveller to loll in an easychair and enjoy it all, but it's a very tiring performance when the glamour has worn off, and simply awful in wet weather in a *doonga*. On the evening

of the third day you may arrive in Srinagar and will admire the picturesque though smelly Venice of the East. Early next morning all sorts and conditions of men will be found hovering like spectres round about your boat with eager eyes and right hands or wallets ever ready to produce the inevitable books with their chits. This you ascertain from the inside of your boat by squinting through the mats. If you value your life and the safety of your *doonga* do not venture forth, but take a quiet survey. One man short and fat with green putties and a very large note-book; another tall, thin and cadaverous; a third with one eye, and that a blue one, and so on. After having had a good look, enquire from your servant who these men are, and you will be told that they are prospective *shikaris*. The struggle for existence being keen, you send for all their books and go through their chits; if you want to see some fun just mix a few up, and gradually weed out the worst until you have only got, say, the three best. Beware of the man who wears green putties and the man who has been with American millionaires and other globe-trotters. You then send for the three men one by one: your choice being effected, you enquire eagerly from the gentleman where he intends to take you, and let us presume you are only going for black bear, at least for the present. He will inform you, and you tell him to go on ahead to make necessary arrangements, leaving instructions behind where to follow. This being done, he will ask for rupees and a pair of binoculars, give the former sparingly, and if you've got an old pair of the latter, lend them, if not, don't; he will also hint at taking one of your rifles, which gently refuse. When the gentleman has disappeared you will doubtless stay a few days in Srinagar for supplies, &c. At last you leave Srinagar and go as near to the happy hunting ground (having got your permit first, of course) as possible in the boat. You then march with tents to the village. On your arrival a figure comes forward and greets you with a *salaam*; you gasp, Who the devil is this?—is it the villain in an Opera Bouffe with apparently 10 suits of puttoo on, grass shoes and stuck all over with knives like a gigantic pin-cushion, and festooned with leather belts and pouches? You look again, and seeing but one blue eye you recognize your long-lost *shikari*. You enquire for *khabbar* and are informed that bears are swarming in the nullahs at the back, as the mulberries are ripe. It is a curious but noteworthy fact, that unless the *tuts* (mulberries) are ripe, you never get anything. If you want bear, the mulberries must be ripe; if you want to fish, the same argument applies, and so on. You then arrange without delay the plan of battle. The *shikari* says you are to sit up in the evenings, and if there is a moon, and you are keen enough at night for a week or so, and this failing "*hānk*" (beat). The *shikari's* great game is to waste time and to give you just as much sport as will keep you going. He does not believe in overpampering his master in the way of *shikar*. In the evening you then proceed to sit up and are

pointed out a rock, far, far away up a hill where you have to perspire to. Now you will see if you have a real genuine *shikari*. As you proceed through brambles and undergrowth behind your *shikari*, if you get swished every two seconds across the face, then you have the satisfaction of knowing that you have got the proper article, as whoever heard of a first class man holding branches for the sahib to pass by safely. You will also have noticed by now that there are, accompanying you, one or two men, perhaps three or four; the greener you are the more there will be, one of them evidently being sweller than the rest. This man is the "gahnwallah" or local village *shikari*, and the others are spotters or pointers who are perched on various elevated places; the places are always elevated because (1) they can see, and (2) its safe. You may begin to ask rude questions about the "gahnwallah," but it is no use doing so, as the professional *shikari* is like the *professional* chowkidar of the plains; only in the latter case if you don't have one, you get robbed; and in the former, you don't get any shooting. It is only blackmail in a way, and as a young Sub. said quite wisely once, "*Shikaris* are mostly rotters, but if you want shooting, you must have one," and this is quite true. You may for the first time in your life be wearing grass-shoes. Oh! the agony!—will you ever forget putting them on? After pulling on two pairs of split-toed socks, which are bad enough, your wretched foot is grasped by the merciless *shikari* and the grass-shoe shoved on after having your big toe nearly pulled sideways out of its socket. Then the whole thing is pulled so tight that if your feet are cold, the agony of walking is intensified; lumps all over the shop, and going downhill your feet are nearly split in two, and you feel like the gentleman with the cloven hoof, only far less lively. However, after a little perseverance you will swear by them. But I am digressing. You are now sweating up the hill, and at last you sit down gasping on the rock. The *shikari* enjoins complete silence, and all the way up the hill you would have been walking on the tips of your toes like a ballet dancer *if you could have found them in those awful grass*-shoes. This habit you will soon get out of when shooting black bear, unless you actually see one close and are stalking it, but this is one of the tricks of the trade played off by the *shikari* on the tyro. You now begin to look round eagerly for bear in the distance, but soon get tired of the game, and instead begin to wonder how much snuff your *shikari* can consume at a sitting. Suddenly, if you have any luck, a bear is spotted by one of the pointers about a mile off in another ravine. Then for another limping and sweating match. When you arrive exhausted at the place, the bear may still be there or not; let us be generous and suppose it is up a mulberry tree. You crawl up as close as possible and pot at him somewhere in the middle. You either miss or don't. If the former, you have not lived up to your reputation as an elephant and tiger destroyer, and are eyed with disgust,

and informed that it was the biggest bear ever seen alive. If you do hit it and it does not drop dead on the spot, it is put down as a rotten shot and your bear goes rolling and running downhill, snarling, growling and howling, into the ravine. (I may here sound a note of warning—never shoot a bear above you if there is any possibility of the animal coming your way, as a bear is heavy and uncomfortable, and its difficult to climb a tree in grass-shoes, at which, however, your *shikari* and "gahnwallah" are usually experts.) You try and follow up your success, but it is getting dark, and a wounded bear is not the pleasantest customer to meet in thick jungle. So you wend your weary footsteps homewards, feeling certain you will never get it, and are sleepless all night thinking about it. Early the next morning you venture forth with coolies and dogs, and if you are lucky, find your first bear dead in the nullah.

The skinning operation then takes place, and the head is chopped off, probably with your very best English hunting knife if you are not careful, and you then march home with an admiring throng, which increases the closer you get to the village. The skin is now pegged out and stretched for all it is worth, if you are not looking, making it long and narrow for the sake of a few inches. You then proudly measure it, and your joy will be unbounded if it is anywhere near 7 feet long, as that is a big animal. After paying the coolies (which don't do in proportion to your joy), you settle down to breakfast and think of your next bear.

E. RADCLIFFE.

Distillation of Rusha Grass Oil, Central Provinces.

THE grass, *Andropogon schœnanthus* or Rusha grass, commonly known as "Tikhari," is a native of Central Provinces. It grows wild in swamps with erect culms, and attains a height of 3 to 6 feet. The leaves are long, smooth, and tapering, and have a strong aromatic smell and pungent taste. The root, locally known as "Mirchia Gand," is perennial, with long wiry fibres.

The oil obtained from this plant has become an important article of commerce. It is now chiefly distilled in many parts of Central Provinces, especially in Betul, Nimar and Hoshangabad districts, by private persons, and taken to Ellichpur town, which is the chief market of export. Its current price is from Rs. 2 to Rs. 4 a pound, according to its purity. The grass is very abundant, and the distilling of the oil requires only a moderate skill and very small initial capital. About 50,000 (fifty thousand) pounds are exported annually from Bombay to Arabia, and European Turkey, Jedda and ports along the Red Sea. Its European name is Palma Rosa oil or Geranium oil.

The oil is chiefly used as an adulterant for *attar* of roses. In some places the roses are sprinkled with it and the *attar* is distilled. It is a proved fact, that "Rusha" grass oil does not

solidify by cold, and this is the chief adulterant which stops the crystallizing habit of rose oil when exposed to low temperature and prevents its congealing.

Rusha grass oil should be first refined before it is ready for admixture with *attar* of roses. It is also necessary that it shoud lose its penetrating aromatic smell and acquire the colour of the *attar* of roses. In order to effect this change it is shaken with water, then acidulated with the juice of lemon, and finally exposed to the sun and air. The oil thus refined has a very slight difference from *attar* of roses, and can serve as an admixture which is very difficult to detect. It is very difficult in these days to procure pure Rusha grass oil, as the oil of commerce is more or less adulterated by the local distillers themselves. The chief substances to adulterate this oil are turpentine and the oils of ground nut, linseed, rape, &c., &c. By such adulteration the oil temporarily becomes turbid, but after a time it settles again and becomes clear. Pure oil should be of a pale sherry colour.

The oil, which is considered to be cooling and astringent, is used as a liniment in rheumatism, headache and skin-diseases, and has the property of curing baldness. It is a powerful stimulent when applied externally, but is never taken internally, except in very minute doses for bilious affections. The grass, as far as I know, is not used as a fodder for cattle.

The grass generally flowers in October and November, and is then fit for cutting. It is tied into small bundles not exceeding 12 inches in circumference, and packed tight, horizontally, in a large metal cauldron, which is fitted on a rough masonry furnace, and then a small quantity of water is added. When full, a roughly scooped-out wooden lid is put and sealed with a plaster of ground pulse, or the lid is more firmly fixed by means of metal clamps. Through a hole in the lid one end of a hollow bamboo is inserted and the other end passed into a smaller metal vessel, which is securely fixed under water in the bed of the river. This smaller vessel serves as a condenser, and the bamboo tube in it is kept in position by pieces of cotton cloth well wrapped round the tube and serving as a stopper for the condenser. The furnace is then heated and the vapour passing through the hollow bamboo tube is deposited as oil in the condenser. The oil thus obtained contains a large proportion of water; 500 pounds of grass yields 2 pounds of pure oil when the still is carefully worked, but if the grass in the cauldron is allowed to burn, it communicates a dark colour to the oil.

With better apparatus, and a more scientific method of distilling, there is much room for improvement and every possibility of success. It might be worth while, for experiment, to reserve for departmental working a certain area and to carefully supervise the results.

HOSHANGABAD: 13*th September* 1901.

A. D. BHOTE,
Forest Ranger.

We have received the following reprint from *Indian Gardening and Planting* from the author Mr. Wright, who asks us to say that any assistance will be gratefully acknowledged :—

Tropical Timbers and their Rings of Growth.

By HERBERT WRIGHT, A.R.C.S.

THERE is probably no more interesting study in timbers than that of the seasonal elements which a transverse section of the stem exhibits. The majority of persons are familiar with the historical tables usually attached to, or painted upon, the successive annular rings of stem sections in the museums and gardens of Europe. The validity of the idea that each ring counts for a definite period of time in the life of the plant is accepted as sound, though in past times much controversy was waged on the nature of the causes producing these time-checking arrangements of the timber elements. The bark pressure theories of Sachs and T. Hartig, the theory of osmotic variation waged by Russow, and the ideas of Weiler and Robert Hartig respecting nutritive supplies to the tree, were all found insufficient to explain the nature of the causes which determined the formation of rings of growth. It was left to the genius of Strassburger and his contemporaries to explain the formation of the rings in terms of the varying physiological needs for the plant.

In temperate zones the deciduous trees burst into new foliage during spring, and the main function which the wood has to perform is that of supplying copious quantities of water to the growing leaves. This is accomplished by the production of large lumined, thin-walled elements, which form connected systems from roots to leaves. During autumn the demand for water is not as great, but there is an increased weight of plant tissue, and the necessary elements to give support and rigidity are added in the form of narrow elements possessing very thick walls.

The thick-walled narrow elements of autumn abut directly on the large elements of the next spring, and hence the line of demarcation showing the limit of growth for any particular year is often very conspicuous. The idea that each ring represents one year of time is therefore correct for those trees in temperate zones which exhibit such periodicities in leaf production. In the tropics, however, where as many as four seasons have each a recognised power, and the arborescent vegetation is often characterised by more than one periodicity in leaf production per year, the time represented by each ring of growth is not necessarily one year.

It is obvious to a casual observer that the very great differences between the periodicities in leaf production of the *Flamboyante* and Cotton trees, or those between the Candle, Almond and Para rubber trees, or better still, between an evergreen having no fixed periodicity and a deciduous tree having the annual regularity of Schizolobium excelsum—such differences must result in the

production of very dissimilar tissue arrangements in the wood of the respective trees. We therefore see that in order to correctly interpret the "seasonal" rings of growth, we must know exactly the characteristic periodicity, and since the climate and vegetation in the tropics are as widely different from those of temperate zones, we may expect the problem to assume some degree of complicity.

In tropical countries, such as Ceylon, where the air is hot and damp throughout the year, the majority of trees are usually considered to be of an evergreen nature. Many of these evergreens, such as species of Cinnamomum and Eugenia, Mango and Jack, &c., have no fixed periodicity, and new leaves may occur any month in the year; others produce leaves at a definite time each year, and of this class the most conspicuous are the Ebony trees. Further, it is worthy of note that those trees of Diospyros embryopteris and Diospyros Gardneri, which as yet have not produced sexual organs, are invariably characterised by a bi-annual foliar periodicity. A comparison between the rings of growth of a young ebony—non-flowering—and one regularly producing flowers, should therefore prove highly interesting. Next to the evergreens we may for comparison place those trees which drop their old leaves simultaneously, but which have produced leaf buds prior to the fall of the old ones, as in Dillenia indica, Rhopalocarpus lucidus, &c. Many others, however, have gone a step further, and the production of new leaves is delayed until the greater part of the old leaves have dropped, and the tree assumes a semi-bare condition, as in Ficus Trimeni. Continuing in this direction we come next to those trees which, like the Inga saman and Candle, are bare for a few days, and finally to those like Erythrina umbrosa, Careya arborea, Bombax, Hevea brasiliensis, Dalbergia frondosa, Plumieria acutifolia, and a host of less familiar trees, which remain leafless for several weeks or months during every year.

There are very few species in Ceylon which drop their old leaves and produce new foliage more than once per year, a notable exception being the almond—Terminalia catappa.

Not only does the foliar periodicity vary with the species, but trees of the same species exhibit great variability, and it is even doubtful whether the same tree produces new leaves at exactly the same time from year to year. These differences must be due either to the varying personal requirements of the plants or the environment under which they exist.

In studying the personal equation of the plant one cannot but conclude that one of the foremost objects in dropping the leaves is to check excessive transpiration. In the Peradeniya districts and in all those parts of the island which feel the dry heat of the N.-E. Monsoon, many of the deciduous trees drop their leaves before or during the hottest months—February to April—and thereby avoid a condition of transpiration which might otherwise prove fatal. The noteworthy examples are Cratæva Roxburghii,

Erythrina indica, Ficus Arnottiana, Sterculia balanchos, Schizolobium excelsum, Oroxylum indicum, Cupania edulis, Antiaris innoxia, the Cotton and Para and Ceara rubber trees, and many others familiar to the tropical tourist. That this is one of the prime objects is further indicated by the behaviour of Careya arborea, Eriodendron anfractuosum, and others in the Bibile and Batticaloa districts, since in these places the production of new leaf is delayed considerably—an obvious advantage where the S.-W. Monsoon is replaced by hot dry weather. If it were necessary to bring proof in support of this idea, one need only point out the behaviour in desert areas where those plants the tissues of which are neither fleshy nor protected by hairs or other contrivances, drop their leaves *prior* to a period of drought. The zerophytic plants having leaves which either in virtue of their succulence retain for a long time the greater part of the water they have obtained, or are so protected by hairs, wax, cuticle, sunken stomata, &c., that loss of water by transpiration is at a minimum, such plants remain evergreen throughout the hottest months. The plants not so adapted must necessarily drop their leaves in order to pervent excessive loss of water. In temperate zones a reversion is seen, since it is during the cool months that the trees become bare, and only when heat and sunshine present their maximum strength that the arborescent vegetation puts on the best show of leaf.

One of the reasons why, in temperate zones, the trees drop their leaf in winter is probably to be found in the fact that the soil is so cold that absorption cannot take place through the roots, and hence no supply being guaranteed, the plants lose their foliage until the warmer weather arrives.

Though the checking of transpiration seems to be one object, it is rather surprising to notice the comparative zerophytic nature of the leaves of Ficus Arnottiana, Ficus Trimeni, and others where the transpiration is probably much less than that from the tender leaves of Brownea grandiceps, and yet the former are deciduous, and the latter is evergreen. Further, we have to face the difficulty that the hottest part of the year is not that chosen by all the deciduous trees, as is instanced by the behaviour of Albizzia procera and Dalbergia frondosa, which become bare in the Peradeniya districts during the dull wet month of July when transpiration cannot be at all excessive. But what is still more difficult to bring into conformity with the theory of checking transpiration is the production of abundance of fresh foliage when the dry heat of the N.-E. Monsoon is asserting its maximum power. This occurs with trees of Sclerocarya caffra and Terminalia melanocarpum during the hot month of March, and similarly Sterculia balanchos and Chloroxylon Swietenia in April. It is highly probable that many of these trees have, in the migration of species, found their way into districts where the climate is not in agreement with their old periodicities. They may, or may not, acquire a new periodicity, and it would be important if we could determine

whether the periodicity of imported species grown from seed remains the same as in the native districts. One might also notice whether a species, native of our country, shows the same periodicity as locally grown trees when introduced again from abroad.

Many of the peculiarities will probably have to be explained on purely personal grounds, since they do not lend themselves to correlation with known environments. The power of the personal equation can be better studied in the tropics than in temperate zones, since the variation of season has such a preponderant influence in the latter areas.

Many instances are known which point to the operation of purely individual forces within the plant. In *Java et ses Habitants*, by J. Chailley-Bert, mention is made of the fact that trees of the same species of Palaquium are growing side by side and under conditions almost identical, and yet one may be bare at a time when the others retain full possession of their foliage.

Mr. Nock also informs me that the English oaks grown at Hakgala, under a comparatively temperate climate, behave in the same irregular manner. This individual variation cannot be better studied than at Peradeniya, where Lagerstrœmia flos-reginæ, a native of the moist low country of Ceylon, grows in abundance. Here, in the month of February, one tree was perfectly bare and yet others only a few yards distant were in full foliage; others were about to drop their leaves, and during the same month one had not only dropped its foliage, but burst into new leaf and followed this by production of flowers. Similarly with trees of Bridelia retusa, also a native of the moist low country. So much then to indicate that internal factors may be at work in determining periodicity of leaf production.

On the other hand, there is considerable evidence in the acclimatisation of trees that the power of environment is very great. A moment's consideration of the powerful influence of a temperate climate on the phases of vegetation is alone sufficient. There are instances which seem to point to the possibility of a new periodicity, without the loss of the old one, being produced by a change of climate. Here we must content ourselves with a few examples which indicate the power of climate. One case of more than usual interest is given by Dr. Watt, Vol. I, p. 46, where the behaviour of Acacia dealbata, *Link.*, indigenous to New South Wales, Victoria and Tasmania, has been entirely changed by the climate in the Nilgiris. The facts are, that in 1845 and up to about 1850, the trees in the Nilgiris flowered in October, which corresponded with the Australian time, but about 1860 they were observed to flower in September; in 1870 they flowered in August; in 1878 in July; and in 1882 they began to flower in June; this being the spring month in the Nilgiris, corresponding with October in Australia. It therefore takes nearly 40 years to regain its habit of flowering in the spring, *i.e.*, to become perfectly acclimatised (*Ind. For.*, VIII, 26).

I am also informed that the English oaks now growing at Johannesburg further illustrate this point, since they begin to drop their leaves towards the end of May, remain bare until near the end of August, when new leaf appears, to be followed by flowers which ripen into fruit by Christmas.

These are very striking examples, and what we are particularly anxious to obtain is a satisfactory table of comparison showing *the behaviour of the deciduous trees under different climates.* The importance cannot be over-estimated, as we shall obtain one string of facts which, together with some knowledge of the rates of growth of the plants in question, will materially assist us in our attempt to interpret the seasonal peculiarities of tropical woods. Having in view the innumerable side issues to which such a problem may lend itself, we confine ourselves to the following points:—

I.—When the plant drops its leaves.

II.—When the new leaves appear.

III.—When the flowers appear.

A list of those plants which are deciduous in Ceylon is now appended in the hope that all interested will forward as much knowledge as they possess respecting the behaviour of any or all of these plants : Albizzia stipulata, Boivin. ; Albizzia Lebbek, Benth. ; Albizzia procera, Benth. ; Antiaris toxicaria, Lesch. ; Anogeisus latifolia ; Acacia suma, Kurz. ; Aleurites triloba, Forst. ; Alstonia scholaris, Br. ; Adenanthera bicolor, Moon. ; Bombax malabaricum, D. C. ; Bassia longifolia, L. ; Bauhinia ; Bridelia retusa, Spreng. ; Cratæva Roxburghii, Br. ; Cochlospermum gossypium, D. C. ; Cassia multijuga, Rich. ; Cassia grandis, Lf. ; Cassia nodosa, Ham. ; Cassia fistula, L. ; Clerodendron Thomsonæ, Balf. ; Cedrela serrulata, Mig. ; Cedrela odorata, L. ; Careya arborea, Gaertn. ; Chickrassia tabularis, A. Juss. ; Chloroxylon Swietenia, D. C. ; Canthium macrocarpum ; Cupania edulis ; Citherexylum cinereum, L. ; Couroupeta guianensis, Aubl. ; Derris robusta, Benth. ; Derris dalbergioides, Baker ; Digellostyles axillaris ; Dipterocarpus zeylanicus, Thw. ; Dipterocarpus hispidus, Thw. ; Dalbergia melanoxylon, G. and P. ; Dalbergia frondosa, Roxb. ; Dillenia indica, L. ; Eriodendron anfractuosum, D. C. ; Enterlobium cyclocarpum, Grisib. ; Erythrina indica, L. ; Erythrina velutina Willd. ; Erythrina umbrosa, H. B. K. ; Eugenia jambolana ; Ficus religiosa, L. ; Ficus Trimeni, King ; Ficus Arnottiana, Mig. ; Ficus Wightiana, Wall ; Ficus infectorea, Roxb. ; Ficus semicordata, Mig. ; Ficus elastica, L. ; Ficus altissima, Bl. ; Flacourtia Ramontchi, L'Herit ; Gmelina arborea, Roxb. ; *Hevea brasiliensis, Muell. Arg.* ; *Heterophragma adenophylla,* Seem. ; Litsea sebifera ; Lagerstrœmia flos-reginæ, Retz. ; Lagerstrœmia tomentosa ; Manihot Glaziovii, Mull. ; Michelia champaca, L. ; Oroxylon indicum, Vent. ; Odina Woodier, Roxb. ; Pithecolobium saman, Benth. ; Pericopsis Mooniana, Thw. ; Poinciana regia, Boj. ; Plumieria acutifolia, Poir. ; Pterospermum semi-sagittatum, Ham. ; Phyllanthus Emblica, L. ; Pahudia Javanica, Mig. ;

Peltophorum Leunei, Benth.; Peltophorum ferruginium, Benth.; Pterocarpus echinatus, Pers.; Pterocarpus marsupium, Roxb.; Pterocarpus indicus, Willd.; Parmentiera cereifera, Seem.; Pityranthe verrucosa, Thw.; Parkia biglandulosa, W. and A.; Rhopalocarpus lucidus, Boj.; Spondias Mangifera, Willd.; Sapindus laurifolia, Vahl.; Sclerocarya caffra, Sond.; Sterculia Balangas; Schizolobium excelsum, Vog.; Stereospermum xylocarpum, B. and Hkf.; Stereospermum chelonoides, D.C.; Stereospermum suaveolens, D. C.; Schleichera trijuga, Willd.; Stephegyne tuberosa; Sarcocephalus esculentus, Afz.; Sapium biglandulosum; Swietenia Mahogani, L.; Styrax Benzoin, Dryand; Terminalia catappa, L.; Terminalia belerica, Roxb.; Terminalia melanocarpum, F. M.; Terminalia parviflora, Thw.; Terminalia chebula; Tectona grandis, L.; Tabebuia Pallida (Lindl.); Tamarindus indicus, L.; Vitex leucoxylon, L. F.; Vitex altissima, L. F.; Zanthoxylun Rhetsa; *Zizyphus glabrata, Heyne.*

Timber Estimating.

BY H. B. AYRES, U. S. Geological Survey.

TIMBER estimators have, as a rule, been reticent concerning their methods. Their employers, who buy and sell on their estimates, do not ask them.

As long as those immediately concerned are constant, there is no need of literature on the subject, but when the value of the property of people inexperienced in sales by estimate is at a stake and the owners have no personal knowledge of the record of the several estimators, they have a right to some idea of the manner of doing the work.

The fundamental principles of estimating are very simple, and consist in ascertaining the number of trees, their dimensions and the percentage of merchantable timber in them. The measurement of a tree is very simple and of little importance.

The principal difficulties of estimating are :—

1. Locating the land to be estimated.
2. Determining the number of trees.
3. Determining the average size of the trees.
4. Determining the percentage of defects.
5. Determining the proportions of the several grades of timber.

In locating land the most intricate problems of land-surveying may arise even where the land has been subdivided into sections, or when subdivided into so-called forty-acre tracts. In such cases the adjustment of errors and the re-establishment of lost and obliterated corners require a high degree of technical skill. *In practice, lines are run and location is kept by compass* and pacing or by transit and chain, according to the accuracy desired and the difficulties of the ground.

The counting of trees may seem a very simple matter, and under some circumstances it is. When all of a small group of trees are in view from one point it is easy to count them, but a large tract of dense timber, or a few timber trees among dense saplings, are different problems.

The defects of timber, whether from rot, crooks, or worm-holes, are matters of close study. They are to be familiarised (though never mastered) only by long study, not only in standing timber, but also in seeing defective logs put through the mill.

In estimating grades of timber that may be manufactured from the timber in question, the highest skill is necessary. In considering methods of estimating, the differences of general forest conditions are also to be borne in mind. That is, whether the forest is broken by openings, such as lakes, swamps, meadows, brushland or burns; whether it is young and thrifty or old and defective. In the application of European methods used in estimating cultivated uniform forests there, to primeval or natural or irregular forests here, there should be great caution; for uncultivated forests rarely have such a uniform stand. That one acre may represent a forty-acre tract, or that any portion of a large forest can be chosen to represent the whole, is a very serious question. In this fact lies a difficulty inexperienced men are apt to stumble over. The selection of representative tracts to be measured or closely estimated to serve as a factor for the whole tract, is a problem the most skilled estimators are reluctant to undertake.

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